



A McGRAW HILL PUBLICATION

ONE DOLLAR

Chemical Engineering

APRIL 1956

◀ **Now find fluid handling
capacity of your tower**

PAGE 193

**Help in combating high
temperature corrosion**

PAGE 175

**Sharpen your ideas about
biochemical engineering**

PAGE 159

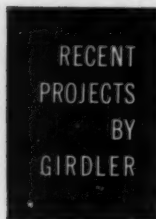
Girdler building \$14,000,000 nitrogen plant ...one of largest in South



Now underway is construction of one of the largest synthetic nitrogen plants in the South. Girdler, as prime contractor, is building it for the Southern Nitrogen Co., Inc., at Savannah, Georgia.

This plant, which will produce 250 tons of ammonia per day for conversion into nitrogen solutions, prilled ammonium nitrate, and urea will raise farming yields and profits in South-eastern states.

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Ammonia Plant for Northern Chemical Industries



Carbon Monoxide Plant for Rohm & Haas

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April

1956

JOHN R. CALLAHAM, Editor

Is This The Job You Want?

Have you always had a hankering to write, to get into technical editorial work?

Do you like to gather, organize, and interpret facts, then to put them on paper? To exchange ideas with other engineers? To demonstrate, to teach, to explain, to pass along useful information?

To keep in touch with what's going on in chemical engineering and in the chemical industries? To see the broad picture?

If so, here may be just the job you're looking for. CE now has an opening for a young editor interested in personal growth and job satisfaction.

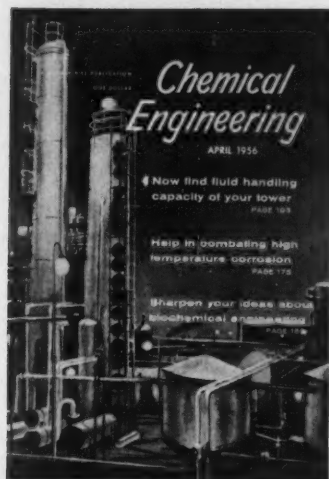
• **Background:** Recent degree in chemical engineering, with sound training in engineering principles. One to three years of experience desirable but not necessary.

• **Abilities:** Able—or eager to learn—to write clearly and logically, to put ideas across fast and clean. Inquisitive and open-minded; eager to accept challenges; personal drive. Able to accept ideas from others and to work with a team.

• **Environment:** New York City, with 10% or more time in out-of-town travel. McGraw-Hill, a growth company, with 34 magazines and 475 editors covering most fields of engineering and industry. As Assistant Editor on CE's staff of 18 engineer-editors.

• **Compensations:** Salary comparable to that in the chemical industry. Liberal personnel policies and benefits. Chance to grow within company. Unusual opportunity to broaden contacts and perspective. Creative environment.

If you have engineering training plus journalistic leanings, and if this summary appeals to you not merely as a job but as a way of life, write now (including all pertinent facts) to John R. Callaham, Editor.



GUIDED TOUR

How to match vapor and liquid loads under your operating conditions

Those bubble-cap towers used for distillation, absorption or stripping—where are the limits of satisfactory performance? You'll find them with this graphical method. You can predict whether or not any tower will work under any desired combination of flow rates and densities. (p. 193)

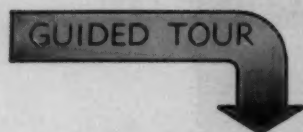
Everybody wins!

What's behind a new personnel plan that truly considers engineers as part of management as well as members of a profession. What's good about this program that benefits your boss, his boss and you. (p. 214)

Fermenting pocesses into profits

Your CE Report this month will sharpen any hazy picture that chemical management

Please turn page



or engineers may have. It's an interpretive survey of the technology of industrial biosynthesis and the role of the chemical engineer as its director. (p. 159)



To beat high-temperature corrosion

Picking the right construction materials gets more involved as process temperatures go higher. These two things have to be done properly: testing with sound methods, applying your test results. Here's how. (p. 175)



Designing exchangers more exactly

You can use these new charts instead of old arbitrary correction factors to find liquid flow through clearance between heat exchanger baffles and shell. (p. 181)



Plant cost estimating (radioactive)

Latest in the CE cost series brings you data where usual estimating yardsticks for conventional plants don't apply. These are important now that private industry is getting into radioactive processing. (p. 185)



Rejoin GUIDED TOUR page 264

Chemical Engineering

APRIL 1956

CHEMENTATOR 103

WHAT'S HAPPENING IN CHEMICAL ENGINEERING

High Speeds Feature New Plating Process.....	114
Radiant Heat Assists Quick Change Act.....	118
Tiny "Plant" Monitors Process Wastes.....	120
Furfural Taps New Source.....	126
Mobile Unit Rids Water of Radioactivity.....	130
Stress-Relieved 200 Ft. Up.....	132
Product Mix Keyed to Demand.....	136

CHEMICALS & RAW MATERIALS

Pyridine on the Comeback Trail.....	142
Index to this month's new chemicals.....	144

FEATURE REPORT

Chemical Technology of Fermentation.....	159
<i>Elmer Gaden, Jr.</i>	

FEATURE ARTICLES

Corrosion Testing at Elevated Temperatures...	175
<i>N. D. Greene, Jr.</i>	
Design Heat Exchangers More Exactly.....	181
<i>Joseph Fabregas</i>	
Estimating Costs for Radiochemical Plants...	185
<i>W. G. Stockdale</i>	
New Look at Batch Extraction.....	188
<i>James G. Knudsen</i>	
Save Money on Bubble-Cap Columns.....	193
<i>T. J. Walsh and P. G. Lafyatis</i>	

CE REFRESHER

Reactor Design for Catalytic Reactions.....	197
<i>T. E. Corrigan and W. C. Mills</i>	

PLANT NOTEBOOK

Pressurized Acid Tank Solves Two Problems..	204
<i>Jorge E. Burguet</i>	

Shortcut Chart for Standard Deviations.....	206
<i>Dale S. Davis</i>	
Installing a Propane Dryness Indicator.....	208
<i>Luis G. Vasquez</i>	
Estimating Steam Film Coefficients.....	208
<i>Liang-tseng Fan</i>	
Graph Solves Three-Component Mixtures.....	210
<i>Arturo Vera, Jr.</i>	

YOU AND YOUR JOB

Here's How You Could Be Treated Better.....	214
---	-----

CORROSION FORUM

Best Designs for Lead Installations—II.....	224
---	-----

PROCESS EQUIPMENT NEWS

Spiral Sizes Powder Cleanly.....	236
Index to this month's new equipment.....	238
New Motor, Sharper Control.....	244

CHEMICAL ECONOMICS

Chemical Profits in '55: the Big Payoff.....	256
Metal Makers Hard Put to Produce Enough... ..	260
Consumption Index	262

PICTURED FLOWSHEET

New Chemical Process Wins Chromium From Ore	308
---	-----

OTHER DEPARTMENTS

Advertisers	466
Book Reviews	332
Convention Calendar	116
Firms in the News.....	341
Man of the Month.....	315
Names in the News.....	316
New Technical Literature.....	432
Pro & Con Letters.....	326
Recent Pamphlets	337

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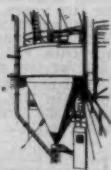
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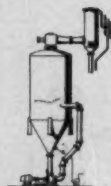
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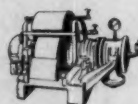
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2

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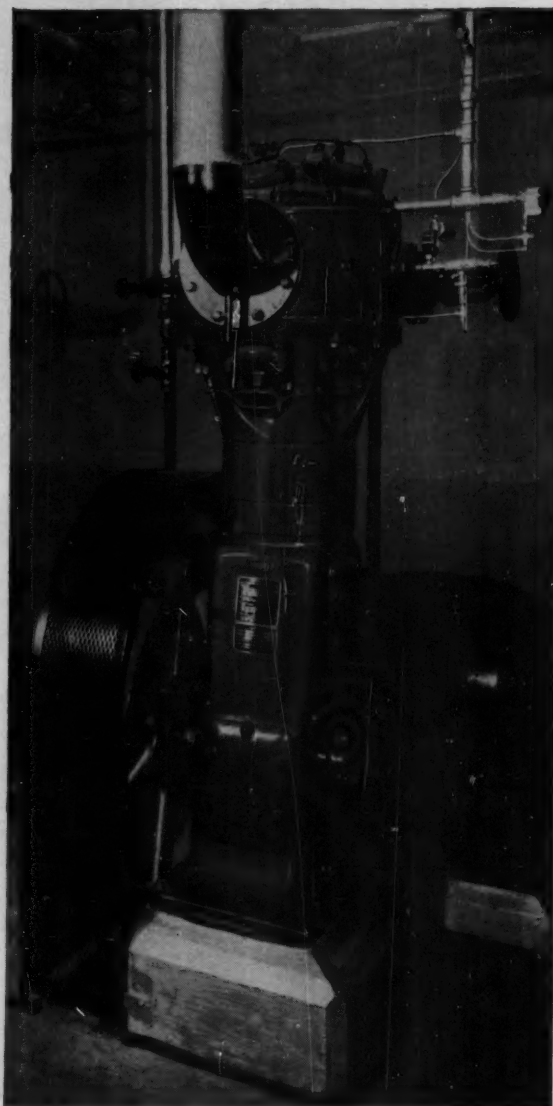
3

SECTIONALIZED CARBON RINGS—Expanders maintain ring-contact with cylinder wall despite wear. Rings last longer.

The Joy WGO-9 "long-rod" compressor is the result of more than twenty years' experience in the design and manufacture of non-lubricated compressors. In addition to the carbon graphite piston rings that need no lubrication, the Joy WGO-9 features special lightweight pistons; large, direct air passages; and liberal waterjacketing to reduce heat and minimize ring wear.

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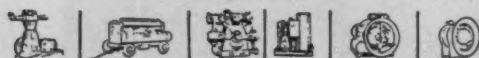
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W-8

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• Bird-Prayon Continuous, Rotary, Horizontal Vacuum Filters
• Bird-Young Continuous Rotary Vacuum Filters
• Bird Horizontal Tank, Vertical Leaf Pressure Filters
• Bird-Humboldt Screen Type Centrifugal Dryers
• Bird Suspended Centrifugals • Bird Centrifugal Classifiers
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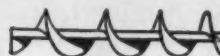


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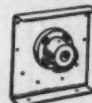
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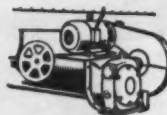
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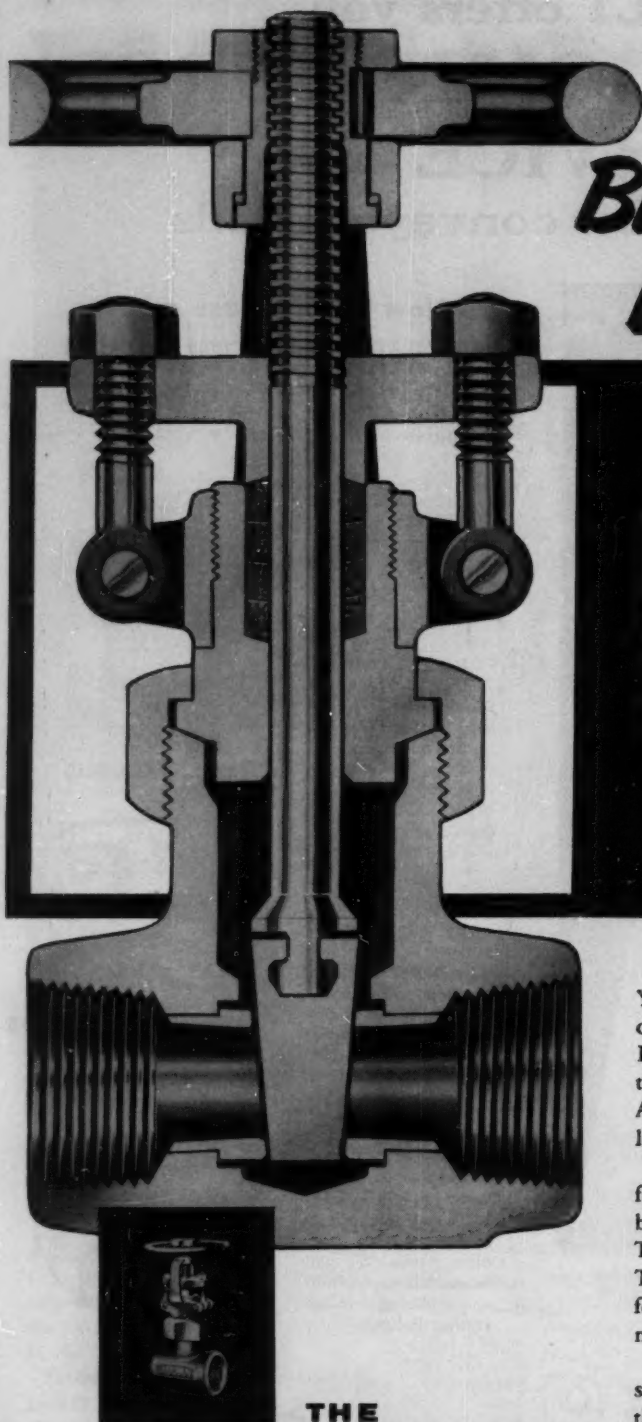
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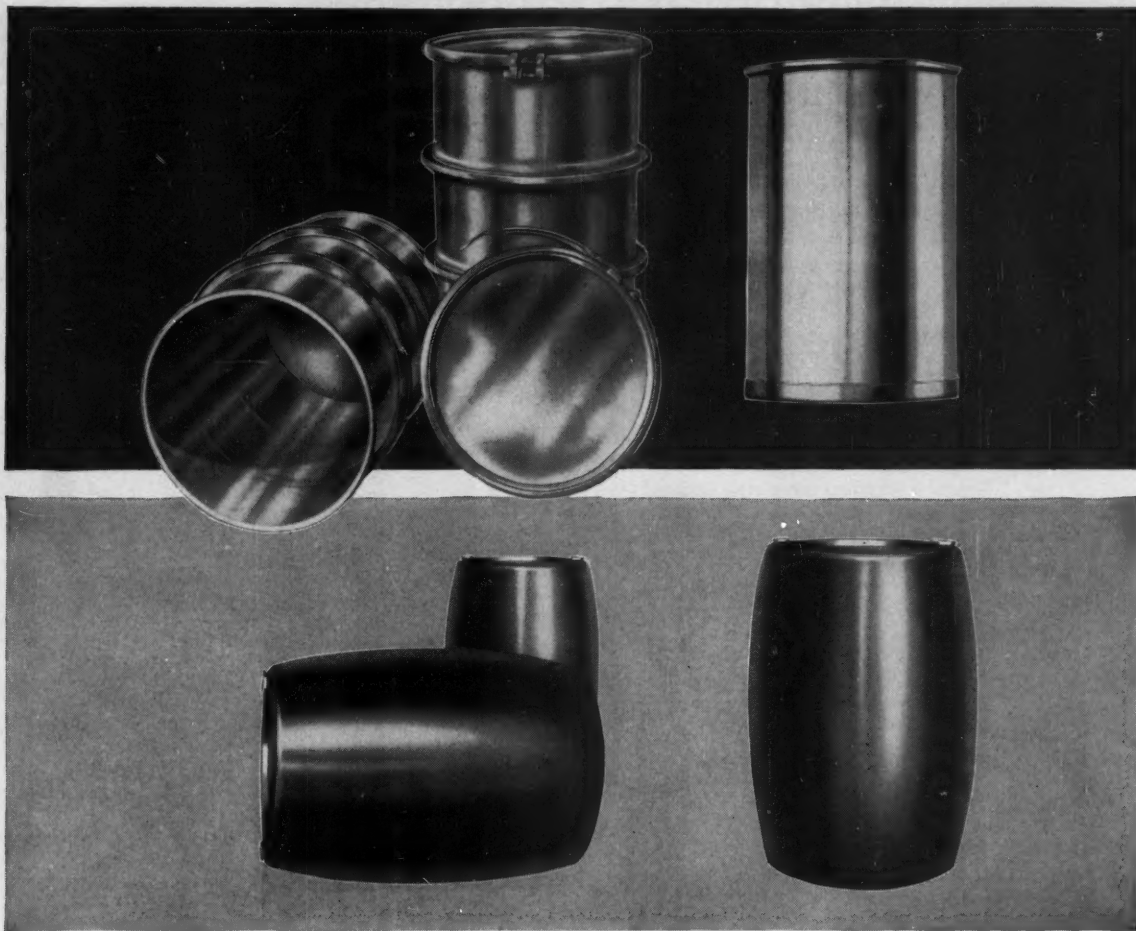
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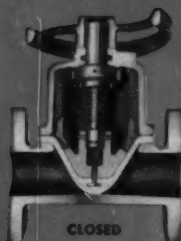
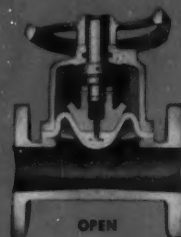
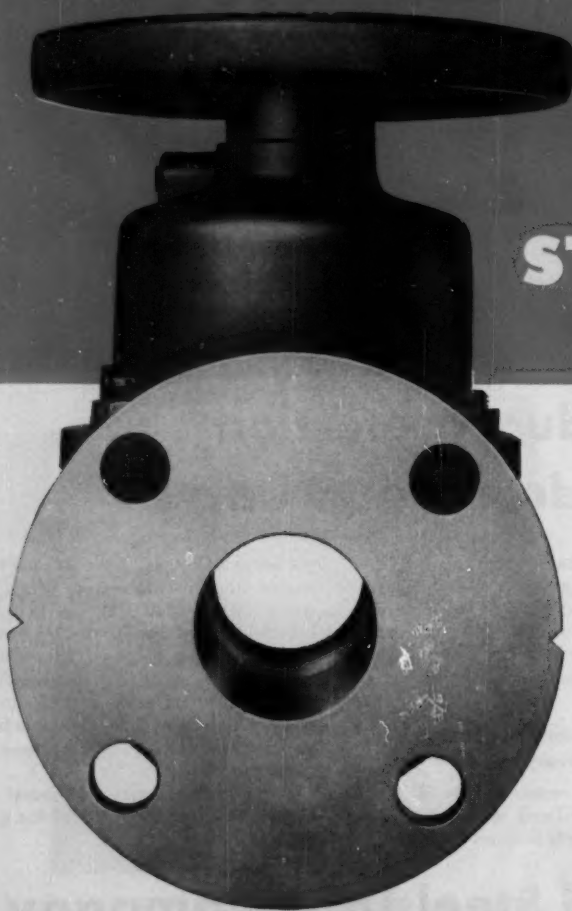
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Flow Characteristics similar to gate valves

- Streamlined straight-through flow
- Minimum pressure drop
- Handles viscous materials without stoppage
- May be rodded or brushed

Advantages of a diaphragm valve

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- Bonnet mechanism completely isolated from fluid in line
- Completely self-draining
- Simple maintenance



GRINNELL-SAUNDERS STRAIGHTWAY DIAPHRAGM VALVE

For handling viscous materials, slurries, sludges, solids in suspension, sewage and corrosive chemicals, Grinnell now offers a valve which has all the advantages of a diaphragm valve with the added benefits of straight-through flow.

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291 West Exchange St., Providence, R. I.

Kindly send me a copy of bulletin describing Grinnell-Saunders Straightway Diaphragm Valves.

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Title

Company

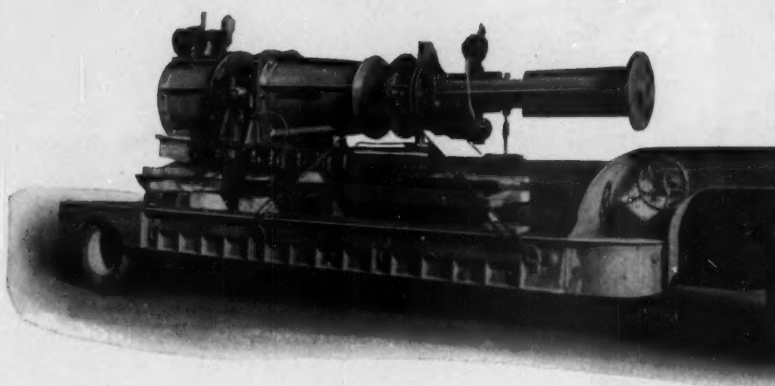
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WE HAVE SERVED INDUSTRY FOR OVER 35 YEARS

Lead Radiation Protection is our Specialty...
Manufactured & Installed to suit your specific requirements



ATOMIC ENERGY ★ NUCLEAR INDUSTRIES

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STAINLESS STEEL EQUIPMENT OF
INTRICATE DESIGN, FABRICATED TO
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EXPERIENCE IN THE A.E.C. FIELD ENABLES
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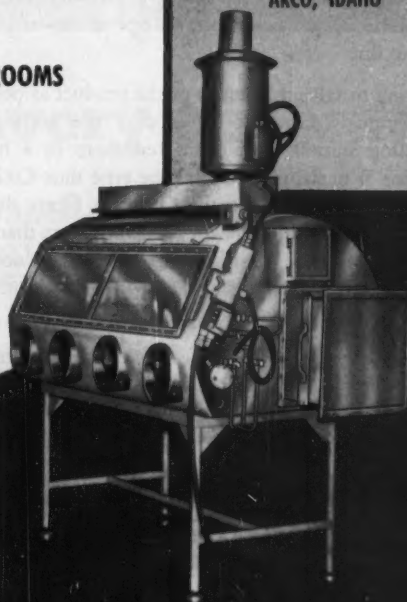
RECENT SHIELDING
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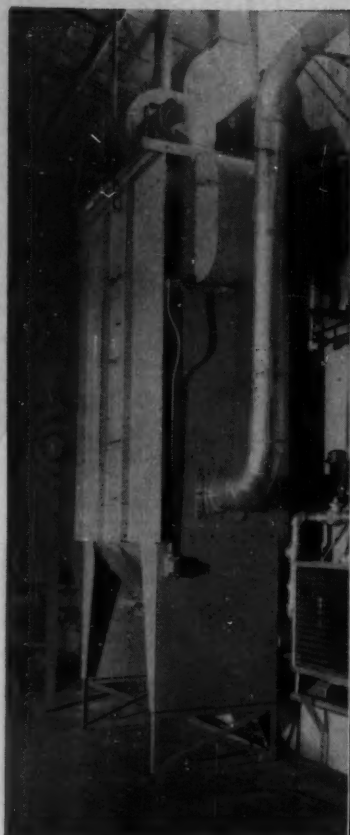
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SIR PROTOTYPE
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MARK I PROTOTYPE
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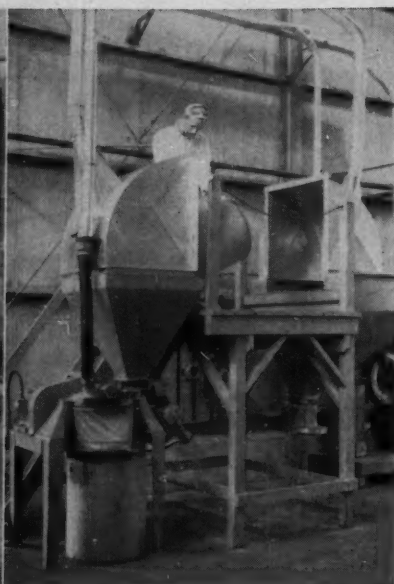
and Company

BOSTON 22, MASSACHUSETTS



HOW NORWICH PHARMACAL CO.

STOPS PRODUCT LOSS



SALVAGES VALUABLE FURACIN WITH A WHEELABRATOR® DUSTUBE® COLLECTOR

Norwich Pharmacal Co. has added 2% to its gross output of furacin by installing a Wheelabrator Dustube Collector to ventilate two operations in its processing line.

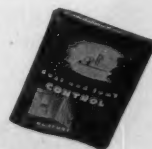
Desiring to salvage as much of the product as possible, the company installed hoods over the milling and weighing stations and connected them to a highly-efficient Wheelabrator cloth tube type dust Collector. The Wheelabrator Dustube Collector filters the fine furacin powder from the air, removing more than 99% of this material. The high rate of recovery not only saves valuable material but it provides a more pleasant and comfortable place to work.

Norwich first learned of the efficiency of Wheelabrator Collectors in its aspirin tableting operations. Here

a Wheelabrator Collector paid for itself by recovering 1% of the total material handled.

Besides direct financial gain, dust and fume removal pays off in better working conditions, and, in many instances, reduced wear and maintenance of machinery. Let the efficiency, simplicity and economy of Wheelabrator Dustube Collectors start paying off for you. Write today for additional information.

*For more details, send now for
your copy of Catalog 372.*



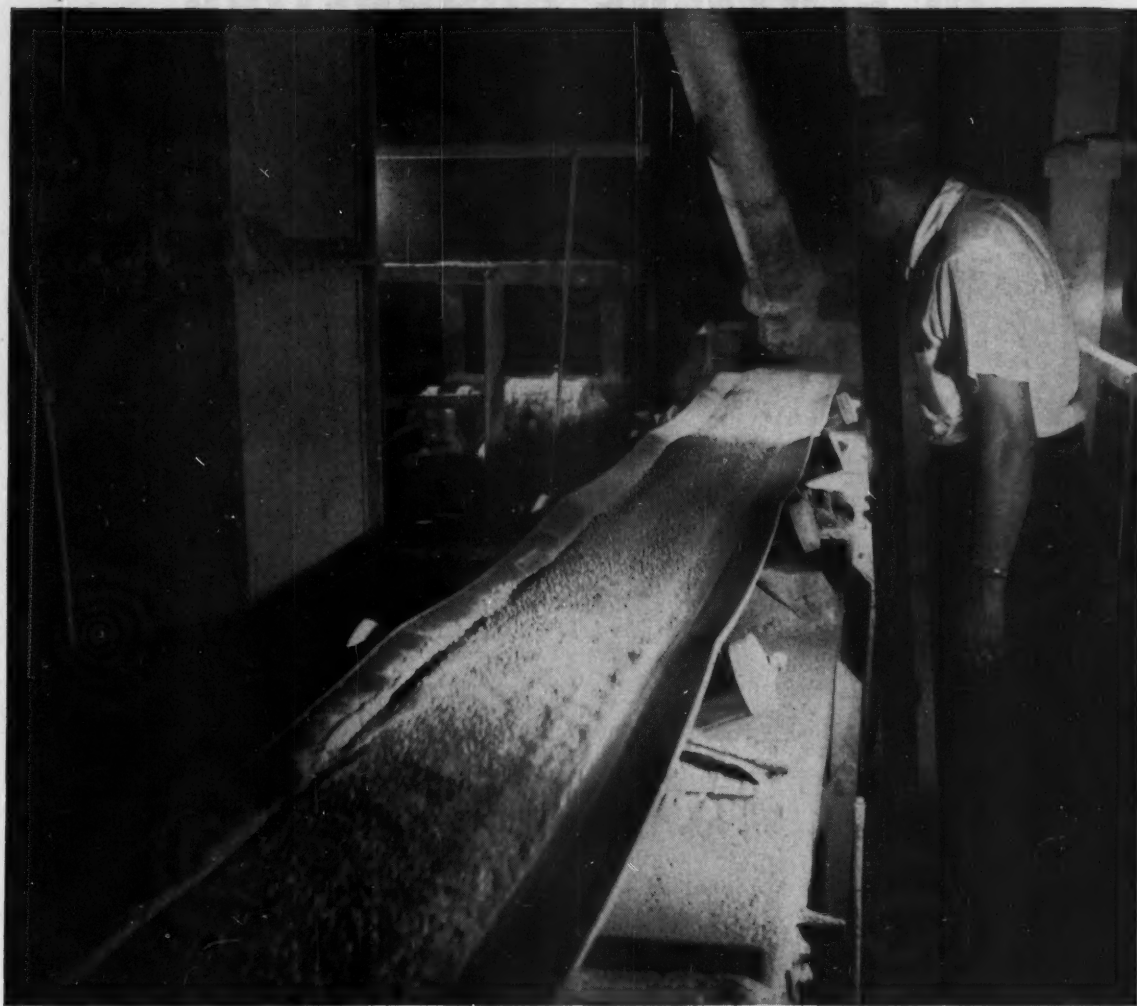
WHEELABRATOR
CORPORATION



347 S. Byrkit St., Mishawaka, Indiana

Trail Blazer of Industrial Progress

B.F. Goodrich



It used to burn up every 6 months

A typical example of B. F. Goodrich improvement in rubber

YOU could smell the belt burning, see the cracks in it. Limestone sand, to be used in making window glass, is heated to 300 degrees, then dumped onto a moving belt to be carried away from the furnace. But the sizzling heat burned out belts of almost every known make—they averaged only six months.

Then an engineer suggested a new, improved B. F. Goodrich hot-material belt, called Solarflex. It's made with a special kind of rubber that stays soft and pliable even at temperatures that cause other belts to harden and crack.

They fastened a length of the new

B. F. Goodrich belting to the hot material belt you see here. The heat ruined the regular belt as usual—but not the Solarflex. It has now outlasted three standard hot-material belts, is still going strong after two years.

B. F. Goodrich conveyor belts invariably save money for users because they're engineered for the special jobs to be done. Some kinds of belts stand crashing blows, lasting far longer than others ever used to last. Some are made to handle wet, sticky or freezing materials without clogging pulleys. Some are made to carry packages and other things up very steep inclines. In

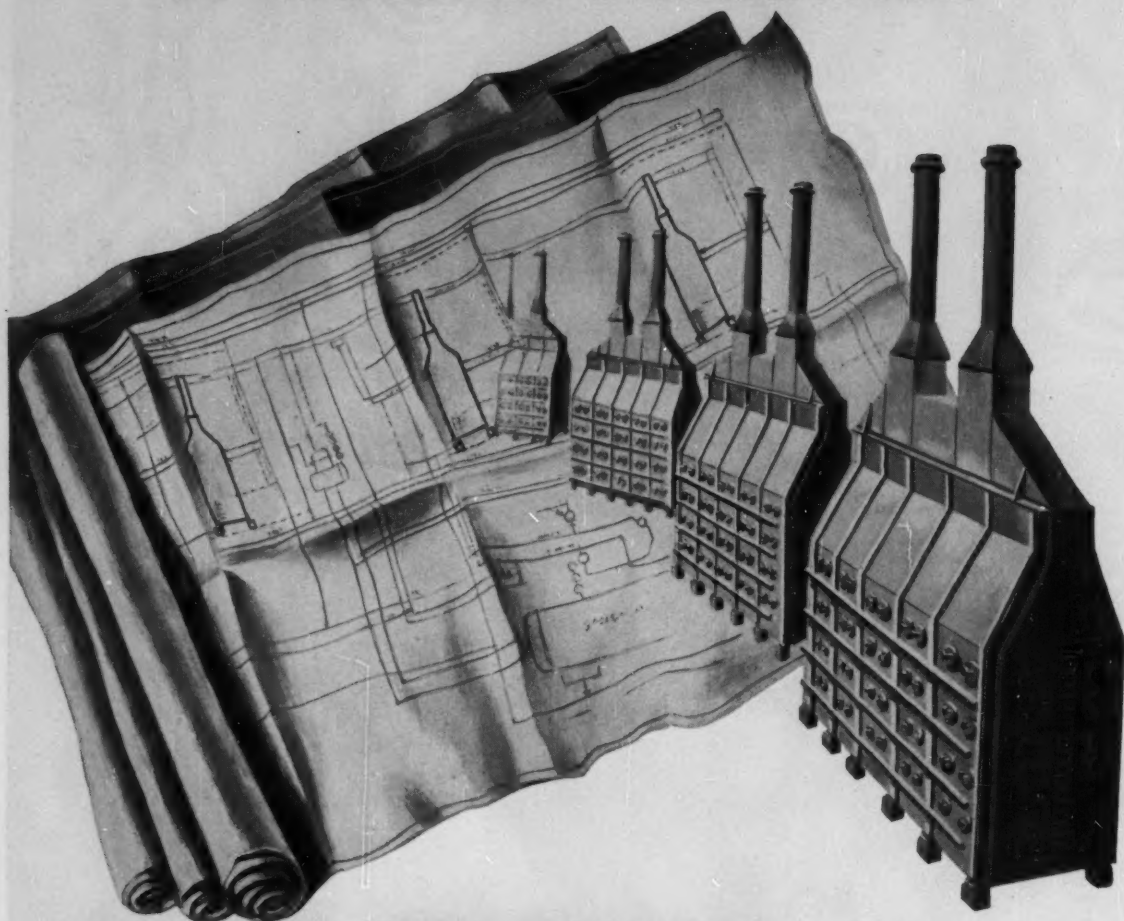
fact, there's a B. F. Goodrich belt for almost every problem.

Call your B. F. Goodrich distributor for more information about any kind of belting, hose or other B. F. Goodrich rubber products. *The B. F. Goodrich Company, Dept. M-607, Akron 18, Ohio.*

B.F. Goodrich

**INDUSTRIAL PRODUCTS
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YOU, TOO, CAN BENEFIT

...from Selas Gradiation® Heating

OPERATION AT THE DESIGNED CAPACITY from the moment of start-up . . . uninterrupted production of ethylene flow . . . versatility in processing different feed stocks . . . are important benefits that will be assured by Selas Gradiation Heating in your new or expanded ethylene operation.

Based on a number of Selas Heaters in ethylene service, you can expect:

- "On stream" periods, without shutdowns, well in excess of 30 days
- High conversions and selectivity
- Zone Control of heat input which enables meeting any time-temperature curve in pyrolytic or catalytic reactions and high temperature preheating.
- Optimum conditions even with extreme variations in feed stocks
- Uniform heat distribution on the entire tube surface extends tube life by eliminating local overheating, and material degradation at the tube wall.
- Controlled combustion, with little or no excess air to cause external oxidation of the tubes . . . no lag in response to controller demand.

Send for copy of reprint, "Try the Gradiation Heater for Economical Ethylene Production" and Bulletin 114, "Gradiation Heating for Petroleum and Chemical Processing."

SELAS
CORPORATION OF AMERICA
DRESHER, PENNSYLVANIA

Heat and Fluid Processing Engineers
DEVELOPMENT • DESIGN • CONSTRUCTION



FAMOUS LIGHTHOUSES OF AMERICA



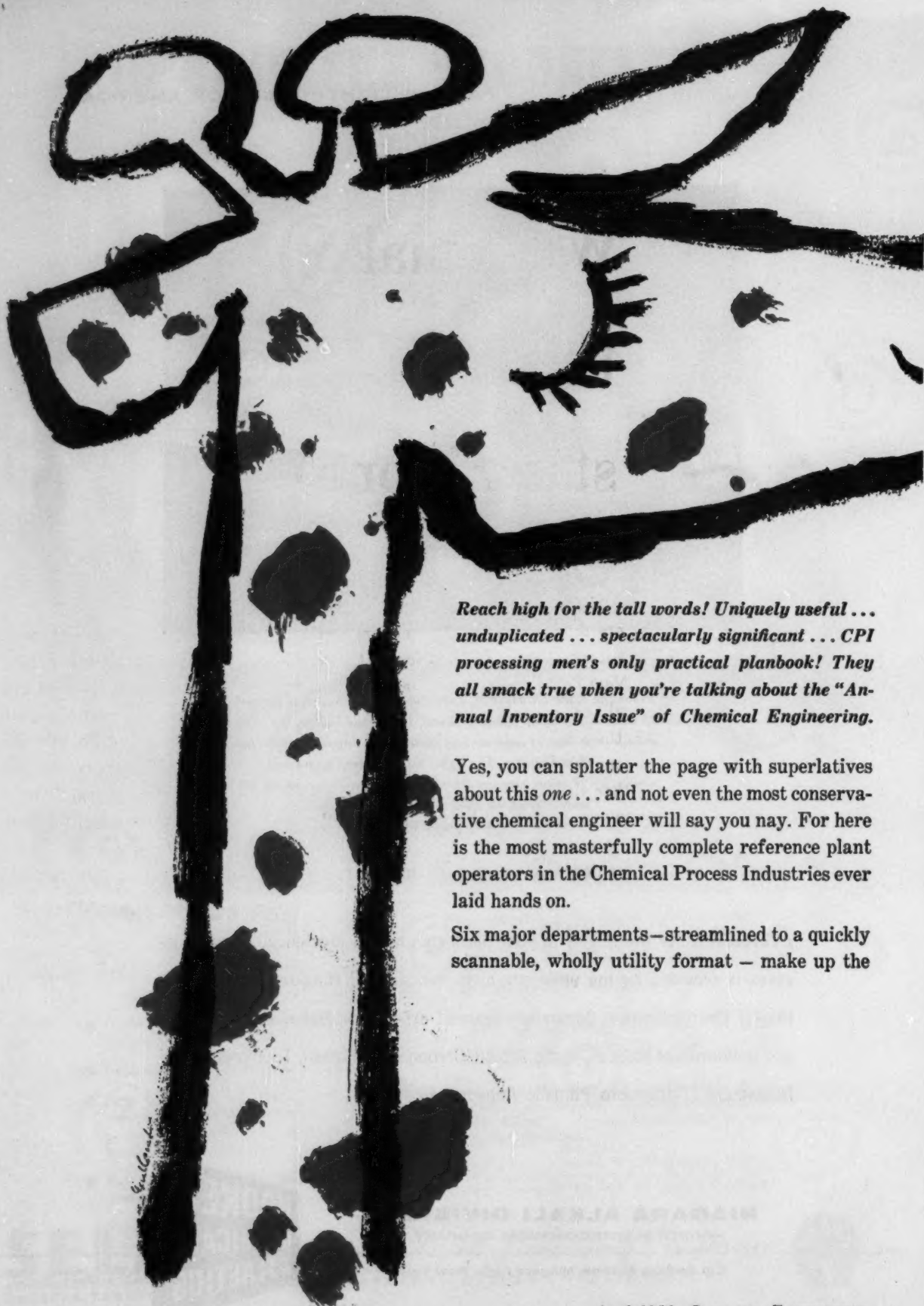
STANNARD ROCK LIGHTHOUSE, Lake Superior, Michigan, is located about 23 miles southeast of Manitou Island. Completed in 1883, the stone tower is built on a base of concrete and stone which stands on solid rock in 11 feet of water. The light, 102 feet above water and visible for 18 miles, protects shipping in a dangerous area on the heavily traveled trade route between Duluth and the lower lakes.

Protection for the quality of your products and the efficiency of your processes is provided by the uniformly high standards of Niagara Alkali and the Hooker Electrochemical Company's years of experience. Depend on the purity and uniformity of Nialk® Caustic Potash, Carbonate of Potash, Trichlorethylene, Niagathal® (Tetrachloro Phthalic Anhydride).

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Yes, you can splatter the page with superlatives about this *one* . . . and not even the most conservative chemical engineer will say you nay. For here is the most masterfully complete reference plant operators in the Chemical Process Industries ever laid hands on.

Six major departments—streamlined to a quickly scannable, wholly utility format — make up the



What makes this one stand alone?

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Published SEPTEMBER 15th

Closing for advertisers AUGUST 1st

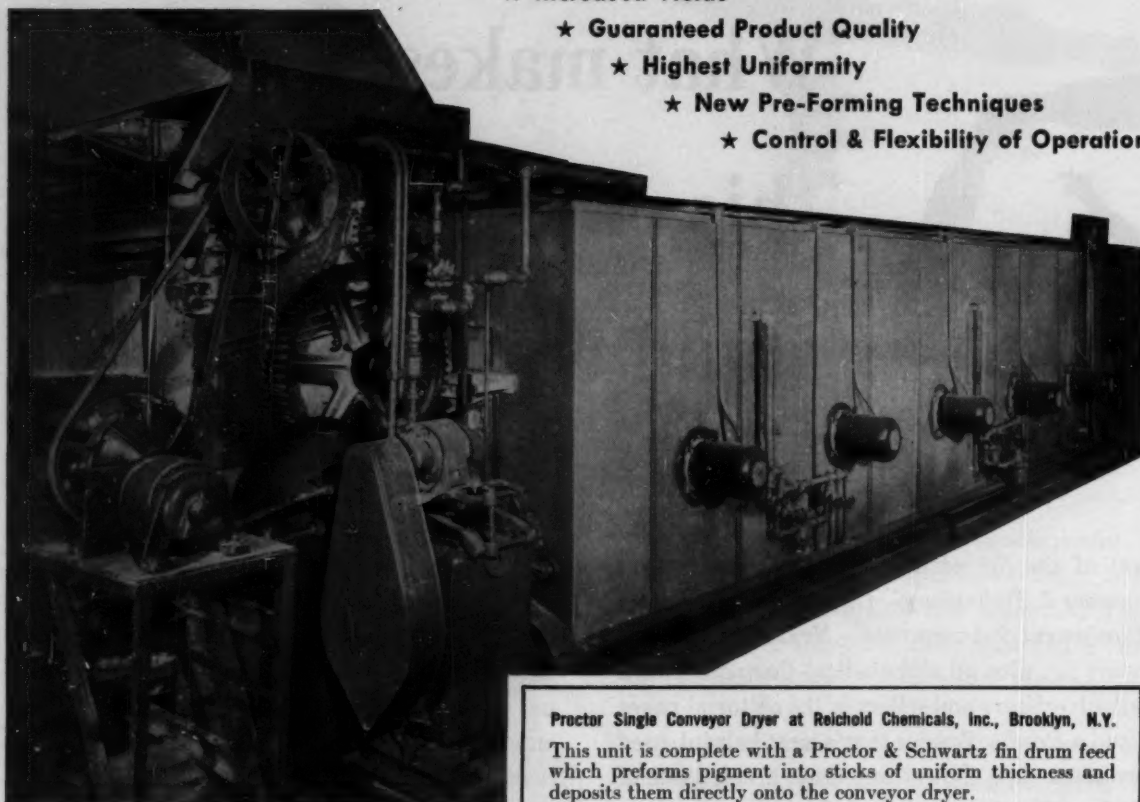
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Chemical
Engineering's
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This unit is complete with a Proctor & Schwartz fin drum feed which preforms pigment into sticks of uniform thickness and deposits them directly onto the conveyor dryer.

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Get full details of these and many other Williams features . . .

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WILLIAMS **NEW** GEARLESS AND SPUR GEAR DRIVES

One of the industry's most outstanding advancements. Cross section of Type D Mill with Spinner Air Separator shows spur gear and pinion drives used on Standard and larger sizes. (Smaller sizes use no gears but have V-belt drive). This type drive is simpler and easier to maintain than bevel gear drives and prevents leakage of material into gear lubricant. Bearing alignment of central shaft is simplified with only two bearings, the bottom one carrying thrust as well as radial loads. Note flow of material being ground by rolls rotating against bull ring, then air swept to separator which discharges fines; returns coarse material for regrinding.

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WILLIAMS

CRUSHERS GRINDERS SHREDDERS



Hammer Mills Roll-Grind Mills Air Separators Vibrating Screens Feeders Impactors

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD



1943

"Progress."

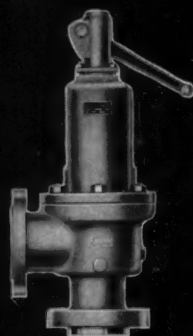


1944

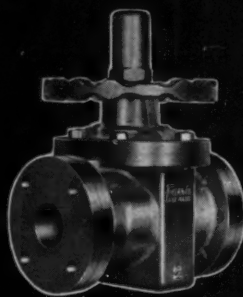


1945

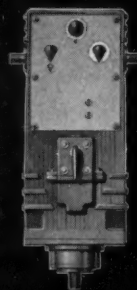
Safety-Relief Valves
Balanced Bellows Valves
Farris Engineering Corp.



Pinch Type Flexible
Diaphragm Disc and
SuperSeal Valves
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Mechanical and
Hydraulic Governors
Farris Pickering
Governor Co., Inc.



1951

U. S. Patents and Patents Pending



1955

.. through honest purpose"

The larger and more experienced a manufacturer becomes, the more he appreciates that **PROGRESS** is not restricted to simply producing fine products at fair prices. Rather, it is the sum total of all the services he renders to his customers day by day and year by year. It is unceasing vigilance to assure customer satisfaction . . . it is constant concern for improvement—for *better* products at even *better* prices . . . it is strict adherence to a commercial code of honor, like Farris' policy of "Progress—Through Honest Purpose".

Evidence of this policy's success is seen in the rapid and constant growth of the Farris organization. And even as you read this, more facilities are being added . . . designed to provide even greater service for users of Farris Safety and Relief Valves (which have set the pace in design and performance and have been duplicated by other manufacturers), Farris "SuperSeal" Flex Valves and Farris Pickering Governors.

Behind our continuing growth and the world-wide recognition of Farris as a pacesetter in its field, is the fundamental belief that "honesty of purpose" when dealing with people is always to be trusted. Upon this belief we have grown . . . and, because they believe in the same things, our customers and friends have supported us. Here, beyond doubt, is proof that the right way to grow is **THROUGH HONEST PURPOSE**.



and HOUSTON, TEXAS

1955

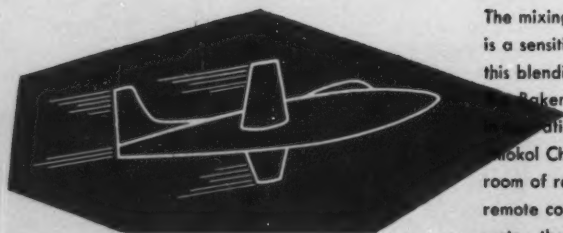
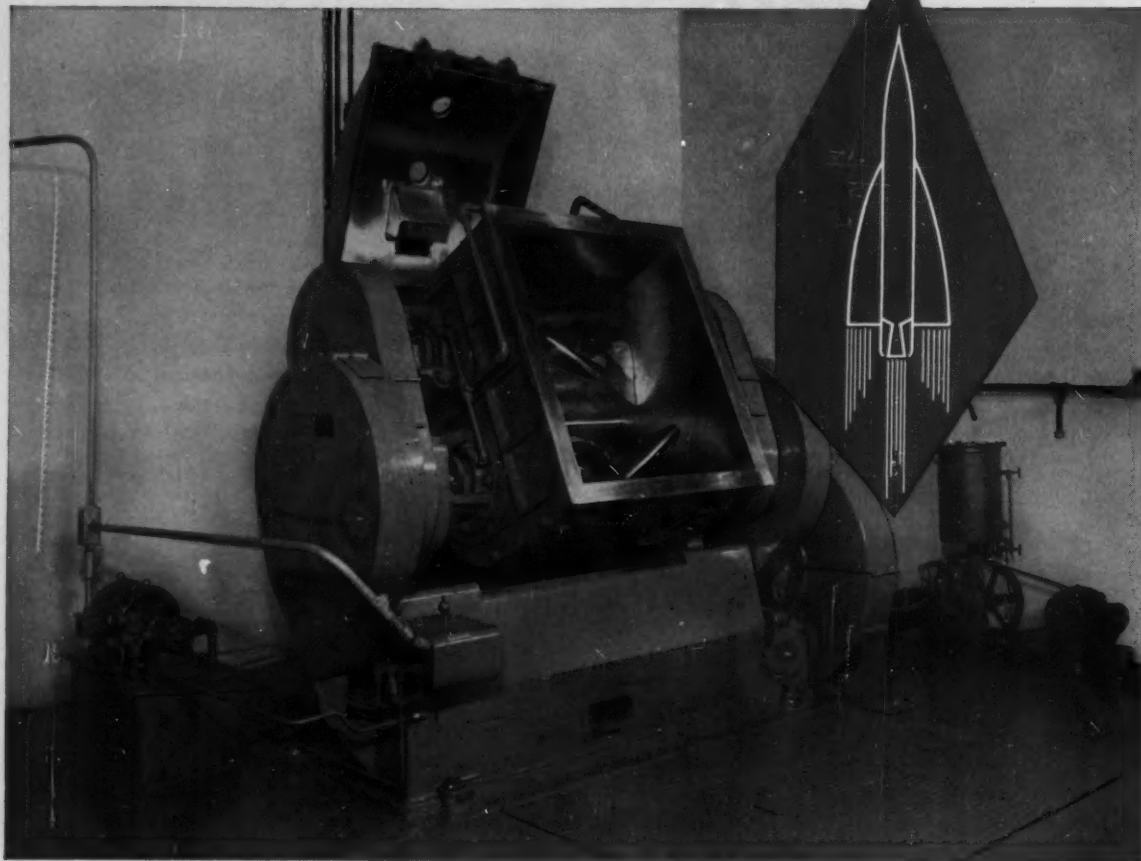


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Thiokol® Chemical Corporation selects
BAKER PERKINS mixers for processing
rocket propellant



Baker Perkins Inc.

Chemical Machinery Division
Saginaw, Michigan

The mixing of rocket propellant from new high-energy fuel materials is a sensitive, highly demanding operation. The mixers which do this blending must therefore be not only efficient, but dependable.

The Baker Perkins No. 15 Mixer shown here is but one of many in the Thiokol Chemical Corporation's equipment line in the rocket propellant field. This unit at the Thiokol Chemical Corporation is enclosed in an explosion-proof room of reinforced concrete, and is engineered for complete remote control operation. Powered by a 50 H.P. silent chain drive motor, the No. 15 Mixer is constructed of Stainless Steel, and jacketed to carry 125 psi pressure of steam or water. Its Sigma blades revolve on anti-friction bearings, hydraulic tilt is provided for the mixing chamber, and the vacuum cover is pedestal mounted. Working capacity of this mixer is 100 gallons, and total capacity 150 gallons. If you have a process that calls for a high-performance mixer, write Baker Perkins for complete catalog.

333



with **METEX** Hi-Thruput **MIST ELIMINATORS**

Collection and recovery of valuable liquid products — removal of liquid particles harmful to subsequent processes — reduced equipment maintenance and decreased air pollution... these are but a few of the possibilities METEX Hi-Thruput Mist Eliminators offer to alert process and project engineers.

METEX Hi-Thruput Mist Eliminators, installed in a process tower or vessel, effect sharp separation of entrained liquids within a wide range of vapor velocities. Pressure drop is negligible. Quality and yield are increased. High removal efficiency is maintained, even at extreme temperatures, due to free-drainage of impinged liquids. Liquid slugs cannot enter turbines or compressors. Coke formation is minimized and life expectancy is substantially increased even under adverse conditions.

Where solids may be formed in the mesh because of decomposition, polymerization, crystallization or freezing, METEX Hi-Thruput Mist Eliminators provide up to three times the service life of conventional units.

In any processing equipment or vessel where liquid entrainment is a contributing factor in design or operation, METEX Hi-Thruput Mist Eliminators assure higher production, better processing and lower operating and maintenance costs.



For complete information and specifications, write today for your copy of Bulletin ME-106, illustrating and describing METEX Mist Eliminators for all process equipment.



METAL TEXTILE CORPORATION
ROSELLE, NEW JERSEY

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Handling Caustics and Alkalis?
Prevent Contamination with
ALCOPLATE*

A chemically deposited nickel plate

In applications where caustics and alkalis are handled, they can be protected with ALCOPLATE against contamination from pipe, valves, pumps and vessels. ALCOPLATE reduces the danger of iron pickup to a minimum, and also resists corrosion of process equipment.

ALCOPLATE can be applied to parts with intricate shapes. It provides a continuous non-porous plating of uniform thickness and eliminates the need for expensive machining of costly metals. Hardness is 45 Rockwell C and can be increased to 70 Rockwell C through post-plate heat treatment. Corrosion resistance? In nearly all applications, ALCOPLATE is equal to or better than pure or wrought nickel.

To prevent contamination and insure long life for your process equipment, call your nearest ALCO

representative. He has complete information on ALCOPLATE performance in specific services. Or write P.O. Box 1065, Schenectady 1, N. Y.

*ALCOPLATE — Trade-mark registration applied for. An application of "Kanigen" a mark identifying the chemical deposition of high-nickel, low-phosphorus alloy by General American Transportation Corporation and its licensees and the coating resulting therefrom — on license from General American Transportation Corporation.

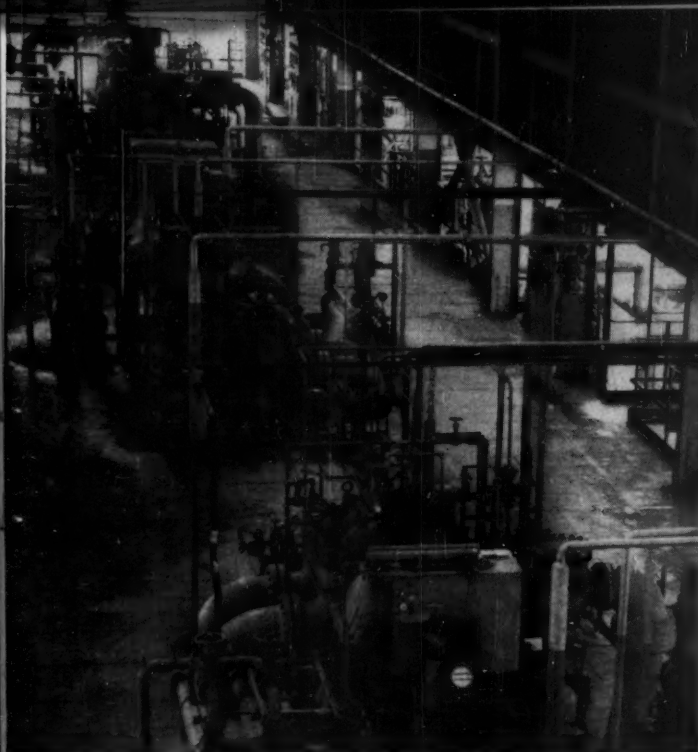
ALCO

ALCO PRODUCTS, INC.,
 New York

April 1956—CHEMICAL ENGINEERING



TURBINES FOR
HIGH-SPEED COMPRESSORS



Six General Electric high-speed turbines operate on 'round-the-clock compressor service at Gulf refinery in Port Arthur, Texas.



For greater bucket reliability, G-E engineer locates "quiet zone" of resonant vibration in buckets to assure that steam-impact frequencies and natural bucket frequencies do not coincide.

MORE THAN JUST RATING AND SPEED . . .

You buy reliability when you specify a G-E High-speed Turbine

IN PROCESS INDUSTRIES, where outages can cost upwards of \$20,000 a day, turbine reliability is a major consideration when specifying compressor and blower drives. General Electric mechanical-drive turbines have built-in reliability features that can assure minimum down-time and greater profits for your operation:

HEAVY-DUTY ROTORS are machined from a single forging to withstand years of continuous high-speed operation. The rotor is completely balanced without buckets, then balanced again as each wheel is bucketed.

EXTERNAL DOVETAIL BUCKETS are attached to wheel rims with machine fit. External construction assures proper force distribution at high speed, gives better rotor protection from moisture erosion.

LARGE PRESSURE PAD BEARINGS furnished on all G-E high-speed turbines minimize shaft vibration. Generous bearing surfaces assure low unit loading for ample lubrication and minimum wear during turbine start-up.

FLANGED CONNECTIONS provide safer oil piping joints, eliminate potential fire hazards. Oil piping gages and pressure switches are arranged to reduce possibility of oil spray on hot turbine parts.

CARBON PACKING used in addition to metallic labyrinth packing assures efficient steam sealing on G-E high-speed turbines. Carbon rings in external packing boxes are non-seizing, have high mechanical strength in the small sizes used.

POSITION RESTORED GOVERNING SYSTEM is designed for close accurate governing in response to load requirement and the slightest variations in steam conditions. Governor will operate with any recycle controlling system.

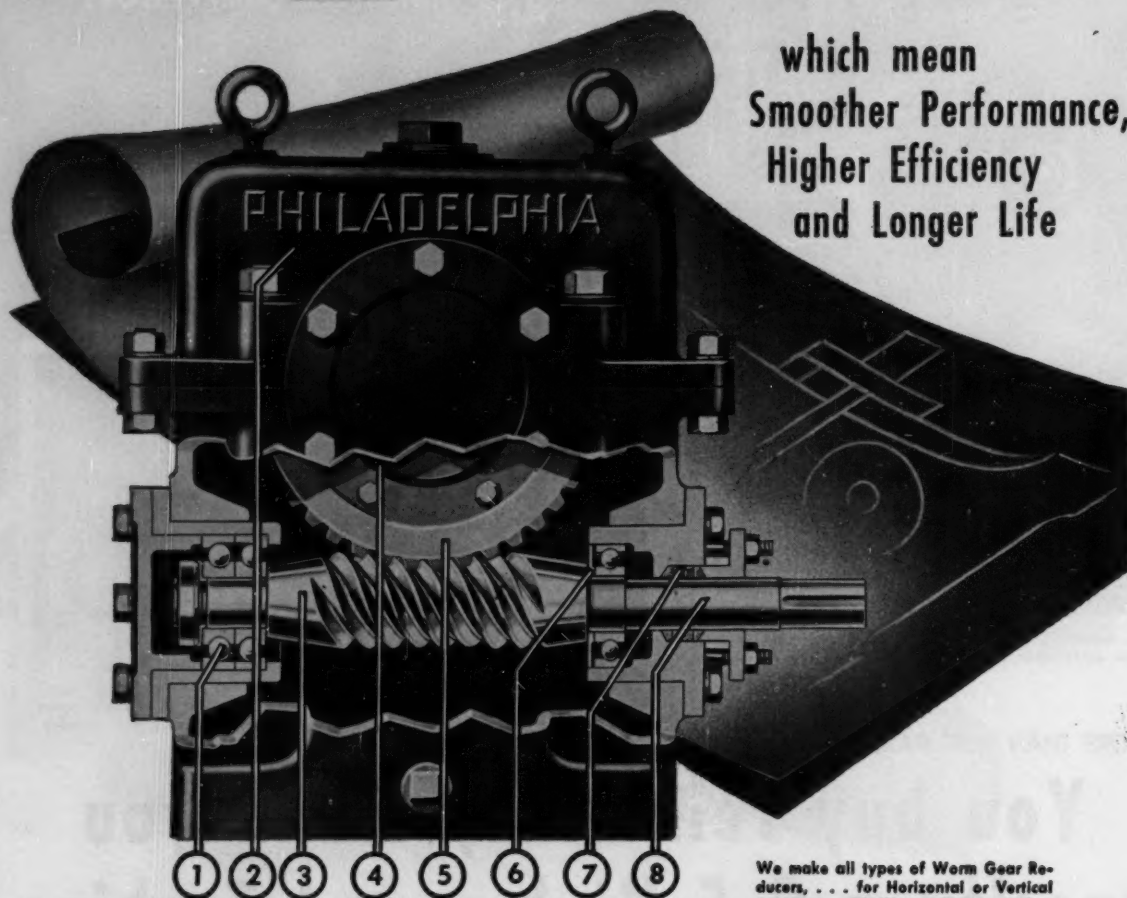
These are but a few of the important design features that account for consistent reliability of General Electric high-speed mechanical-drive turbines. For further information, contact your nearest G-E Apparatus Sales Office, or write for new bulletin GEA-6232, General Electric Company, Section 241-5, Fitchburg, Mass.

Progress Is Our Most Important Product

GENERAL  ELECTRIC

YOU GET ALL THESE ADVANTAGES...

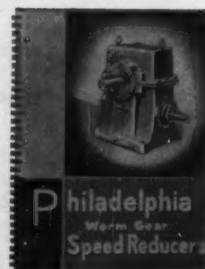
which mean
Smoother Performance,
Higher Efficiency
and Longer Life



- 1.----- BEARINGS throughout are of highest quality, calculated to take all loads and stresses in accordance with maximum ratings of units.
- 2.----- EXCEPTIONALLY RIGID HOUSING of best grade cast iron . . . Strengthening ribs integral with design.
- 3.----- WORMS made of SAE 3115 Steel with carburized and hardened threads. Shaft and threads smoothly ground after hardening.
- 4.----- GEAR SHAFT BEARINGS run in an oil well that automatically fills with fresh oil when filled from top. Splash from the gear keeps the wells filled to the overflow point.
- 5.----- WORM GEAR made from quality chill cast nickel bronze bolted to a semi-steel center. (Smaller sizes are solid bronze.)
- 6.----- WORM AND WORM BEARINGS run in oil bath. Baffle plates prevent flooding.
- 7.----- WORM SHAFT equipped with stuffing box to prevent oil leakage.
- 8.----- SHAFTS are premium quality. Always accurate, straight, concentric.

We make all types of Worm Gear Reducers, . . . for Horizontal or Vertical mounting; with Worm above or below Worm Gear; in Single, Double or Triple Reductions for medium or heavy duty service; any horsepower or reduction ratio.

Tell us your Speed Reduction problems, and a Philadelphia Sales Engineer will gladly call upon you, . . . without obligation.



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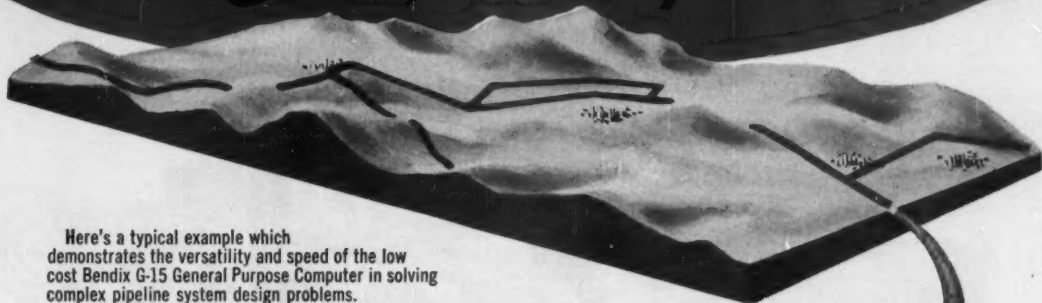
Industrial Gears & Speed Reducers

LimitTorque Valve Controls

Established 1892

GIVES THE ANSWER TO PIPELINE DIFFERENTIAL PRESSURES...IN SECONDS!

Bendix Computer



Here's a typical example which demonstrates the versatility and speed of the low cost Bendix G-15 General Purpose Computer in solving complex pipeline system design problems.

A proposed system of pipelines 160 miles long with 1800 feet variation in altitude, was to consist of a number of pipes of different diameters running in parallel over eleven given sections. At the end of the sections, gas was to enter the flow from another source or be branched off to another destination. In addition, two compressors were to be placed at various sections along the line.



6 SECONDS TO SOLVE EACH STATION

After the problem has been entered into the Computer only 6 seconds per section are required to solve and print the answer for each station, giving pipeline pressure, flow rate of the gas and the mile posts.

In addition, the Computer requires only 8 seconds to provide the following for each compressor calculation: fuel used, brake H.P., sea level H.P., compression ratio, suction pressure and discharge pressure.

The Bendix G-15 is an entirely new concept in electronic computation. Its unusually low cost, large capacity and speed make it an economically sound investment for research, engineering and control functions, even for so-called "small" company operations.

Let us send you complete information on how the Bendix Computer can effectively serve you.

Bendix Computer

Bendix Computer Division, Bendix Aviation Corp.
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Tell us how we can economically use the Bendix Computer in our engineering, research and control functions.

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COURTESY OF COLLIER'S MAGAZINE

AIR CONDITIONED TRIPOD

**Texas Tower radar "Island" keeps cool with
AIRTEMP Air Conditioning**

Under a blazing summer sun, this off-shore air defense Texas Tower radar "island" could literally cook the Air Force crews that man it. But not with Airtemp air conditioning on the job!

Cool, clean, healthful air, provided by packaged chiller units, helps keep radar crews alert...helps precision radar stay accurate. Thus, men and equipment alike perform efficiently in this vital link of our early warning network.

It's unusual air conditioning to be sure, but just a routine application for top engineers of Airtemp Construction

Corporation. As air conditioning specialists, these men provide efficient systems for buildings, offices and stores of every kind.

Their experience, plus years-ahead engineering by Chrysler, assures dependable, trouble-free air conditioning through the years.

When you specify Airtemp, you help clients cut operating costs, attract new business, increase profit dollars. Let your Airtemp distributor give you the facts. Or, write: *Airtemp Construction Corp., Dept. CE-4-56, Dayton 1, Ohio.*

Airtemp
CONSTRUCTION
CORPORATION

SUBSIDIARY OF CHRYSLER CORP.

**AIRTEMP BUILDS
AIR CONDITIONING
TO MEET
EVERY REQUIREMENT**

U.S.I. CHEMICAL NEWS

Mar.-Apr.

★

A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries

★

1956

Polyurethane Foams Claimed Exceptional For Lightweight Insulation

Can Be Made With
"U.S.I. Iseobacic" Acid

The unique combination of desirable properties indicated for polyurethane foams has given rise to the prediction in some quarters that the market for these relatively new materials will increase in the next five years from a few hundred thousand pounds to one hundred million pounds annually.

Outdoor clothing manufacturers are already investigating the flexible foam varieties—cold-setting products formed by mixing a diisocyanate with a polyester resin—as a possibility for lightweight insulating materials. Here's why! Polyurethane foams, it is claimed, are long-lasting because they are tough, highly resistant to the deteriorating effects of temperature extremes (—40 to 300°F), rot, vermin, sun, air, salt water, detergents, solvents, dilute acids, oils, aromatic fuels, and other agents which might come in contact with clothing in outdoor use, cleaning, storage and shipping.

The warmth versus weight factor is outstanding. A $\frac{1}{8}$ " interlining gives the warmth of a sheepskin coat at a fraction of the latter's weight and bulk. These foams are highly tear resistant, and can be sewn by hand or machine without fabric backing or covering. They are waterproof and fire retardant, and take dyes in any color from pastels to deep hues. If these claims are substantiated over a long term testing period, the U. S. Government would probably be a major customer for garments incorporating polyurethane flexible foams for the armed forces.

The new product "U.S.I. Iseobacic" acid shows good possibilities as a raw material in the formulation of the polyester resin used in the production of flexible polyurethane foams. "U.S.I. Iseobacic" acid is now in pilot plant production with a full-scale commercial unit scheduled to come onstream early in 1957.

Methionine Shows Promise In Treatment of Falling Hair

The sulfur amino acid methionine may be an important factor in the prevention of baldness and treatment of falling hair. Clinicians report that a preparation containing a solubilized form of methionine (N-acetyl DL-Methionine) in combination with an estrogenic hormone diminishes the excessive loss of hair when applied topically. The high sulfur amino acid content of human hair suggested the possibilities of the methionine treatment.

NEW ANHYDROUS ALCOHOL UNIT COMPLETED

New Installation At Tuscola, Illinois
Believed To Be The World's Largest Unit

A new anhydrous ethyl alcohol unit has just been placed on stream at the expanding chemical center at Tuscola, Illinois. Probably the largest ever built, its production will supplement that of existing U.S.I. anhydrous alcohol units

Method of Laying Endless Plastic Pipe Disclosed

A recently issued patent discloses a method of laying endless pipe, without joints, at a speed of several miles per hour. A plastic pipe extruder mounted on a tractor extrudes the pipe continuously as the tractor moves forward.

The use of plastics in the field of liquid transportation should be broadened by this new method of laying pipe. It will be particularly useful where rapid installation is desirable and extreme pressures are not required.

New Tests Shed More Light On Ammonia Activity In Soils

Missouri scientists have advanced our knowledge of ammonia activity in the soil several more steps in recent months. In tests applying 100 pounds of anhydrous ammonia per acre of silt loam, they found that the nitrogen released made available by chemical reaction 47 pounds of additional phosphate and about four extra pounds of potash. These compounds were already in the soil but in forms not available to growing plants.

Effects of moisture content on ammonia retention were established in these tests. It was found that ammonia losses were very low when applications were made in soil at an optimum 15-18% moisture content. At a 3 inch depth, the loss was 1% in 36 hours. The workers also concluded that dry soils hold ammonia far better than extremely wet soils.

Finally it was confirmed that ammonia additions increase the alkalinity of soils, contrary to the belief in some areas that soils become more acid.

You Can Receive U.S.I. Chemical News By Mail

You can be sure of seeing every issue of the U.S.I. Chemical News by writing, on your company letterhead, to the Editor, and requesting that your name be added to the U.S.I. Chemical News mailing list.

at Anaheim, California and New Orleans, Louisiana. The Tuscola site was chosen for this plant to permit integration with subsidiary National Petro-Chemicals Corporation's synthetic alcohol plant at this location.

Anhydrous alcohol from the three plants will be distributed from U.S.I.'s Tuscola, Chicago, Newark, Anaheim and New Orleans denaturing plants and from U.S.I. warehouse points throughout the country. It will be available as pure anhydrous alcohol, completely and specially denatured anhydrous alcohol and anhydrous SOLOX® and FILMEX®, two of U.S.I.'s proprietary denatured alcohol solvents.

U.S.I. built the world's first commercial anhydrous alcohol plant back in 1919, and the Company has since then maintained its position as the leader in that field.



New anhydrous alcohol unit

Mar.-Apr.

★

U.S.I. CHEMICAL NEWS

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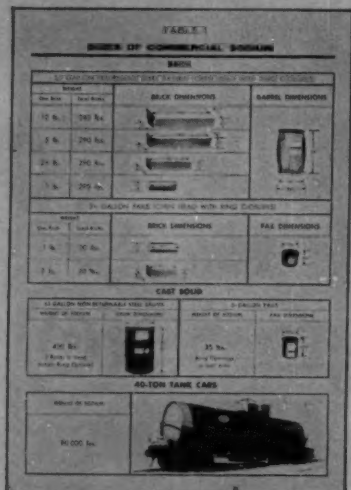
1956

New Book Answers Questions On Sodium Handling

Now available from U.S.I. is a revised, greatly expanded edition of the brochure, "Handling Metallic Sodium On A Plant Scale."

This is a comprehensive and completely up-to-date treatment of sodium handling technology, containing information such as details of typical sodium-using processes; details of equipment installation, insulation, etc.; recommendations for sodium pumping and instrumentation; recommendations for safety in design and operation.

A thorough engineering text, this book will be a valuable reference to anyone engaged in design or operation of a sodium handling process. The many diagrams, tables and photographs in the text will help the reader to visualize the operation of a well-designed sodium-using plant.



Sample page from U.S.I.'s new 40-page brochure, "Handling Metallic Sodium on a Plant Scale."

Alcohol Users Can Measure Drum Contents By Stick With New U.S.I. Charts

Alcohol and solvent users can now obtain charts for determining the contents of 55-gallon drums at various temperatures by stick measurement from U.S.I.

The information was compiled from measurements of 190 and 200 proof alcohol in standard ICC-17E drums (35 inches by 24 inches). For other liquids in drums of the same dimensions, the quantities listed on the charts will be found approximately correct.

These charts will be found useful for general inventory purposes where it is desired to make approximate measurements with a minimum of effort. They are obtainable as 8½ x 11 catalog sheets and as 17 x 22 wall charts, from your local U.S.I. sales division or from the New York office of U.S.I.

Urethan May Be Key To Safe Vaccination Against Newcastle Virus

Research at a Midwest experiment station on the effect of urethan on the multiplication of Newcastle disease virus suggests the possibility of producing a noninfectious vaccine against this disease in poultry.

A drawback of present commercial vaccine is that whole flocks may become infected following vaccination. Researchers found, however, that when urethan was used to attenuate the Newcastle virus it caused a complete loss of infectivity of the virus.

It is believed that the effectiveness of urethan may lie in its prevention of complete synthesis of the infectivity titer fraction of new Newcastle virus particles. By direct action on the protein material of the virus, urethan may inhibit further virus multiplication.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Laboratory handling of radioactive materials to insure safety is thoroughly outlined in a purchasable 41-page booklet prepared by the National Fire Protection Association's Committee on Atomic Energy. **No. 1140**

Squeezable polyethylene tubes for packaging are now being coated internally to cut down permeation of oils and oxygen. Manufacturer believes tubes now suitable for 80% of products formerly unsatisfactory in polyethylene. **No. 1141**

New textile fabric, of polyethylene plus conventional yarns, is woven flat but becomes permanently 3-dimensional when dipped in boiling water. Process yields textures for drapes, upholstery and carpets not obtainable otherwise. **No. 1142**

Potassium thiocyanate labeled with radioactive carbon-14 now available as an intermediate for study of plastics, metallic complexes and in radio-chemical analysis. **No. 1143**

Two new bodying agents for coating systems now offered commercially. One is a liquid viscosity modifier for non-thixotropic viscosity increase without affecting flow or leveling. The other is a thixotropic bodying agent in powder form. **No. 1144**

Via principles of gas chromatography, new vapor fractionator reportedly gives fast, precise analyses of gases and volatile liquids, and is simple in calculation. Qualitatively, clean separations of difficult isomers can be obtained. **No. 1145**

A sulfur amino acid is reported to improve the coat of fur-bearing animals. Field tests indicate that when 1 lb. of the amino acid is added per ton of dry ration, depth and density of underfur are markedly increased. Ability of young to survive after birth is also improved. **No. 1146**

Automatic burette, just introduced, has squeezable reservoir bottle for convenient filling with automatic finding of zero point. Reservoir is attached by heavy threaded polyethylene cap—avoids forcing of rubber stoppers. **No. 1147**

Package units for producing sodium dispersions can now be obtained, eliminating need for sodium researchers to build their own equipment. Units are complete in every detail and ready to set up. **No. 1148**

Odor-free emulsion-coupler for flexible polyester foams recently developed to permit production of plastics with low odor level. Recommended for incorporation at 1 to 2.5% based on total weight of reactants. **No. 1149**

PRODUCTS OF U.S.I.

ALCOHOLS:

Ethyl Alcohol (Ethanol)—Specially denatured—all regular and anhydrous formulas.

Completely denatured—All regular formulas for industrial use, anti-freeze. Pure alcohol—USP 190—Absolute, N.F., taxfree, taxpaid.

Butanol (Normal Butyl Alcohol)—Latent solvent for nitrocellulose, solvent for ethyl cellulose, many resins, many chemical syntheses.

Amyl Alcohol, Refined—Fine chemicals, pharmaceuticals.

Fusel Oil, Refined—Blend of amyl alcohols refined by chemical treatment, distillation.

Proprietary Denatured Alcohol Solvents

SOLOX®—General-purpose.

FILMEX®—Special, authorized for certain industries.

ANSOL® M—Anhydrous, special blend for lacquers, resins, etc.

ANSOL® PR—Anhydrous, special blend with higher ester content and solvency for lacquers, resins, etc.

OTHER PRODUCTS:

PETROTHENE® Polyethylene Resins.

Inorganic Chemicals: Ammonia, Caustic Soda, Chlorine, Metallic Sodium, Sodium Peroxide, Sulfuric Acid.

Esters, Ethers and Ketones: Normal Butyl Acetate, Dibutyl Phthalate, Diethyl Carbonate, Diethyl Oxalate, Ethyl Acetate, Ethyl Ether, Acetone.

Intermediates and Fine Chemicals: Acetoacetylaldehydes, Ethyl Acetoacetate, Ethyl Benzoylacetate, Ethyl Chloroformate, Ethylene, Ethyl Sodium Oxalacetate, Sodium Ethylate solution, Urethan USP (Ethyl Carbamate).

Animal Feed Products: Calcium Pantothenate, Choline Chloride Products, Curbay B-G® 80, Special Liquid Curbay®, DL-Methionine, Nicotin USP, Riboflavin Concentrates, Vitamin B12 and Antibiotic Feed Supplements, Vacatone® 40, Vitamin A, D, and K3 Products.

Pharmaceutical Products: DL-Methionine, N-Acetyl-DL-Methionine, Riboflavin USP, Urethan USP, Intermediates.

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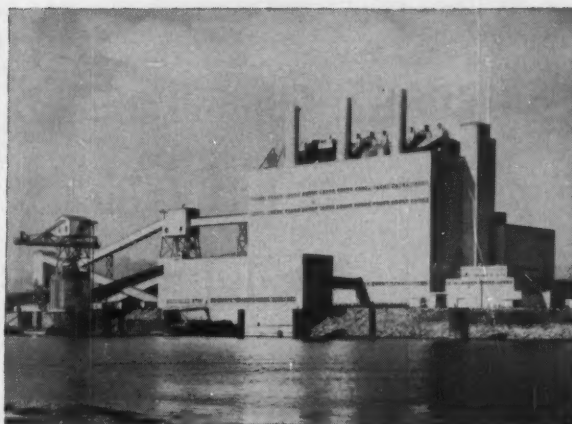
INDUSTRIAL CHEMICALS CO.

Division of National Distillers Products Corporation
99 Park Avenue, New York 16, N. Y.

The modern 310,000 kw Elrama power plant of the Duquesne Light Company, near Clairton, Pa., is completely sheathed in ALCOA Industrial Building Sheet to reduce maintenance costs, improve appearance. The use of lightweight ALCOA Aluminum curtain wall construction allows easy removal of panels for building modifications or additions.

In addition to aluminum siding, windows, tread-plate, handrails and many other ALCOA Aluminum products offer high corrosion resistance, low cost in hundreds of applications.

This huge, 1-mile-long coal conveyor of the Philadelphia and Reading Corporation, located near Mahanoy City, Pa., is covered with ALCOA 3003 corrugated aluminum sheet. The aluminum covering has successfully resisted the high acid-sulfate atmosphere for twenty-five years. ALCOA Aluminum is also used extensively as siding on buildings at this installation.



ALCOA Aluminum protects this prilling tower from corrosion in an ammonium nitrate plant of the Mississippi Chemical Company, Yazoo, Mississippi. The tower is 120 feet high, 20 feet in diameter, and is one of many applications in which ALCOA Aluminum can be used successfully and economically.



These service installations prove **ALCOA ALUMINUM** resists weathering

SERVICE EXPERIENCE

There have been many opportunities to examine samples of ALCOA Aluminum alloys from actual installations in service for periods up to 52 years in widely scattered localities. These installations involve roofing and siding of alloys 1100, 3003 and 3004; fencing of alloy 3004 and electrical conductors of EC grade aluminum either as all-aluminum cable or as aluminum conductor steel reinforced (ALCOA ACSR). The exposures were evaluated by measurement of depth of attack. In practically all cases the attack was shallow and generally less than that for related aluminum alloys exposed at ALCOA's weathering stations at New Kensington,

Pennsylvania, and Point Judith, Rhode Island. The data from these relatively severe exposure stations can be used, therefore, to estimate the performance expected from aluminum alloys when subjected to the weather at most industrial and marine localities.

Investigate ALCOA Aluminum today. Get all the facts. They're in the new, free, double reprint, *Resistance of Aluminum Alloys to Weathering, and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres*. Use the coupon to obtain your free copies.

Tune in "The Alcoa Hour"—NBC Television. Alternate Sunday evenings. See your newspaper for time and station.



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Accurate, measurement of pressure differentials up to 300 psi

HAGAN DELTA 'P' PRESSURE TRANSMITTER

The Hagan Delta 'P' Transmitter is a sturdy, compact, force-balance instrument for pneumatically transmitting large pressure difference measurements. Consider these features:

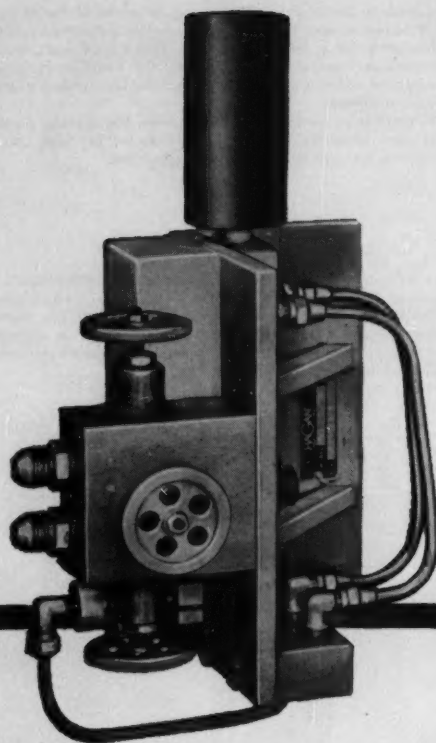
1. No stuffing boxes, torque tubes or pressure-tight bearings.
2. Not affected by static pressure changes.
3. Usable at any static pressures up to 3000 psig.
4. Full scale pressure difference measuring ranges from 50 psi to 300 psi with 1% full scale accuracy.
5. Shut-off and by-pass valves integral with instrument.
6. Not damaged by accidental application of full line pressure to either side of measuring element.
7. Stainless steel pressure elements, cadmium-plated steel frame.
8. Shock and vibration proof design.

HAGAN CORPORATION
HAGAN BUILDING, PITTSBURGH 30, PA.



Systems and Components for: Boiler Combustion Control, Metallurgical Furnace Control, Process Control, Aeronautical Testing Facilities • Industrial Water Treatment • Chemicals for Water Conditioning

HAGAN SUBSIDIARIES: CALGON, INC. • HALL LABORATORIES, INC.



A few Applications of the Delta 'P' Transmitter

Pneumatic signals from the transmitter are in the range of 0-30 psig, and may be used for indications and records, or for control of factors involved in such functions as:

Pressure difference between steam and boiler feedwater headers.

Steam pressure drop across superheater.

Pressure drop between boiler outlet and turbine throttle.

Pressure drop across high pressure heat exchangers.

Measuring pressure drop across liquid flow control valves for graduated control of pump discharge pressure.

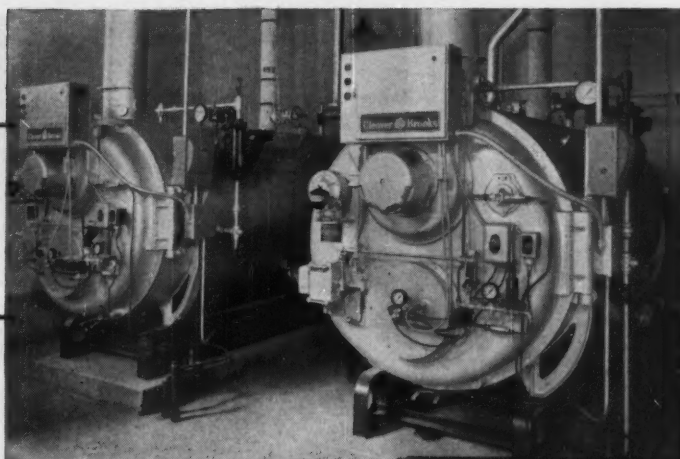
As a "square root" flow meter when pressure differentials are higher than conventional flow meter design.

Measuring pressure differentials for alarm signal purposes under critical operating conditions, such as seal gas pressure during repair periods in a catalytic reformer unit.

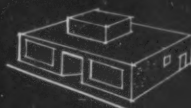
—18— sizes

—110— models

15 to 600 hp

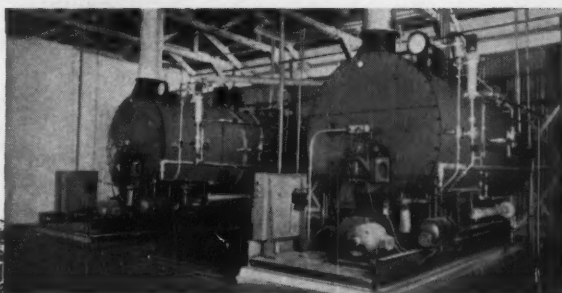
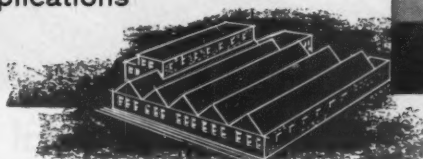


CB SERIES — The ultimate in compact, quiet-running boilers. Sizes: 15 to 150 hp.



yours from Cleaver-Brooks

the broadest line of cost-saving "packaged" boilers—for hundreds of applications



LR SERIES — Standard of the industry for hot water or steam service, for heating or processing. Sizes: 200 to 600 hp.

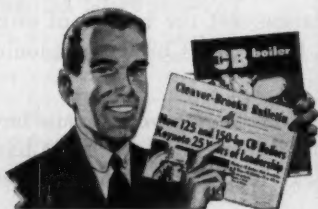
THE two installations above are representative of Cleaver-Brooks' broad range of standard models. The wide choice makes planning and selection of a boiler for your specific needs — large or small — a simple, time-saving procedure.

Your nearby Cleaver-Brooks representative, with years of specialized boiler experience, can be of real service to you. Working with you and your engineers, he can help you to find ready answers to questions of size, loads, present and future steam or hot water needs, space and equipment arrangement. Where local conditions dictate, oil, gas or combination oil/gas firing can be selected for greatest savings. And once installation is com-

pleted, arrangements are made for factory-supervised starting and training your operator.

Keep in mind, too, the many fuel and maintenance-saving advantages of four-pass design with forced draft . . . the standard equipment electronic combustion controls which assure continuous, safe operation.

Cleaver-Brooks boiler owners enjoy all these advantages and share in the combined application engineering experience of more than 19,000 individual boiler installations. Put this experience to work for you. Cleaver-Brooks Company, Dept. D, 344 E. Keefe Ave., Milwaukee 12, Wis., U.S.A., Cable Address: CEEBEEWEST — all codes.



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*Handled by Standard Brass & Mfg. Co.

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**Chase® Antimonial Admiralty
resists dezincification—adds
years to heat exchanger tube
life!**

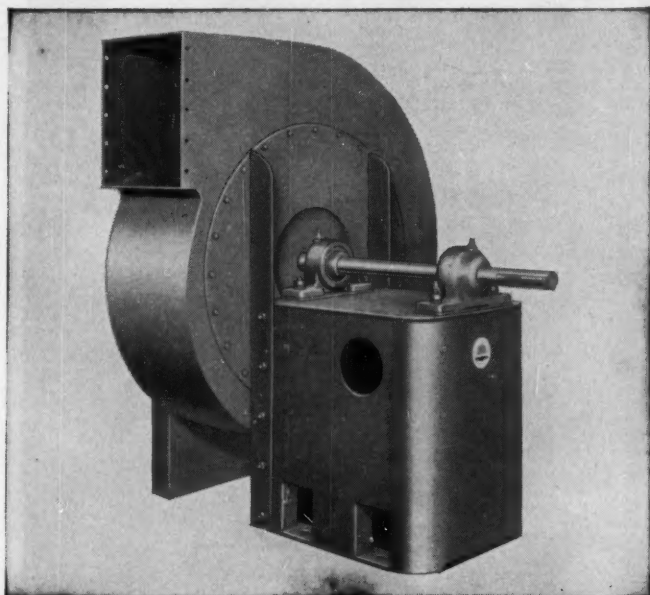
Chase Antimonial Admiralty Heat Exchanger Tubes contain the *right* amount of antimony needed to resist dezincification and other forms of corrosion. That's why *Chase* tubes last so much longer!

And antimony will *not* weaken the tube in other ways! That's why *Chase* tubes *stay* sound through years of adverse conditions in the field!

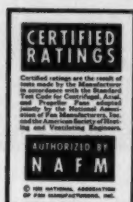
When you replace Heat Exchanger Tubes, or plan a new installation, get the benefit of *extra* years of service. Insist on Chase Antimonial Admiralty.

Learn more about corrosion problems, and how Chase can help solve them. Send for free Chase Condenser and Heat Exchanger Tube Booklet.

NEW FEATURES! HIGHER EFFICIENCIES! NEW "3-IN-1" DESIGN! AMERICAN BLOWER SERIES 106 INDUSTRIAL FAN



Series 106 Industrial Fan



Certified ratings! Pressures to 18" w.g.! Volumes to 125,000 cfm! Heavy construction! Choice of 3 special-duty wheels! You get all these features, and many more in American Blower's new Series 106 Industrial Fans.

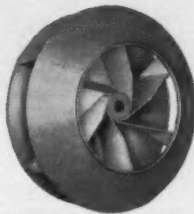
Available in 16 sizes, each with a high efficiency rating. Series 106 fans offer a wide range of optional accessories and construction features to meet standard or special specifications — or you can buy it in 7 sizes as an efficient, heavy-duty "packaged" industrial fan, complete with motor, V-belt drive and weathertight running-gear enclosure.

Get complete data from your nearest American Blower Branch Office, or write for Bulletin 5306-H.

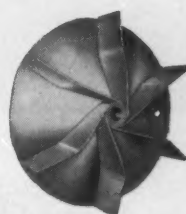
Choose the wheel to fit the duty



Air Handling — for efficient handling of air, fumes, or gases — either clean, or containing light concentrations of dust or materials.



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Long Shavings — specially designed for conveying or handling air or gases containing long stringy material — wood shavings, fibers, alfalfa.

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Thirty-five years of expanding application have demonstrated the value of "Virginia" Liquid Sulfur Dioxide (SO_2) in over 40 diversified industries. This versatile, low-cost chemical, when teamed with "Virginia" technical know-how, has proved most satisfactory as a reducing, bleaching and preservative agent, neutralizer, reaction medium, antichlor, and pH control.

"Virginia" is a national leader in the production of SO_2 . This leadership enables you to draw upon unexcelled production, storage and shipping resources for prompt deliveries in any quantities you need. No order is too large or too small.

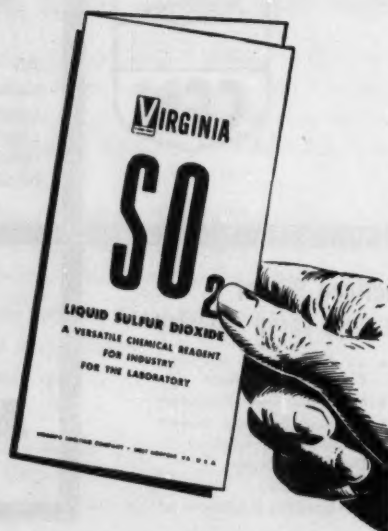
The chances are good that our SO_2 can cut costs and improve your prod-

ucts or processes. We'd like to explore these possibilities for increased efficiency and economy with you. Send today for our SO_2 folder—or ask us for any aid our technical staff can give you.

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If you have ordered West End soda ash you are sure of top quality . . . but that is only the beginning of West End service. Your requests in matters of routing, scheduling, invoicing and advices are both invited and encouraged. They are attended to promptly and cheerfully. Feel free to make requests . . . no matter how small . . . at any time.



West End Chemical Company

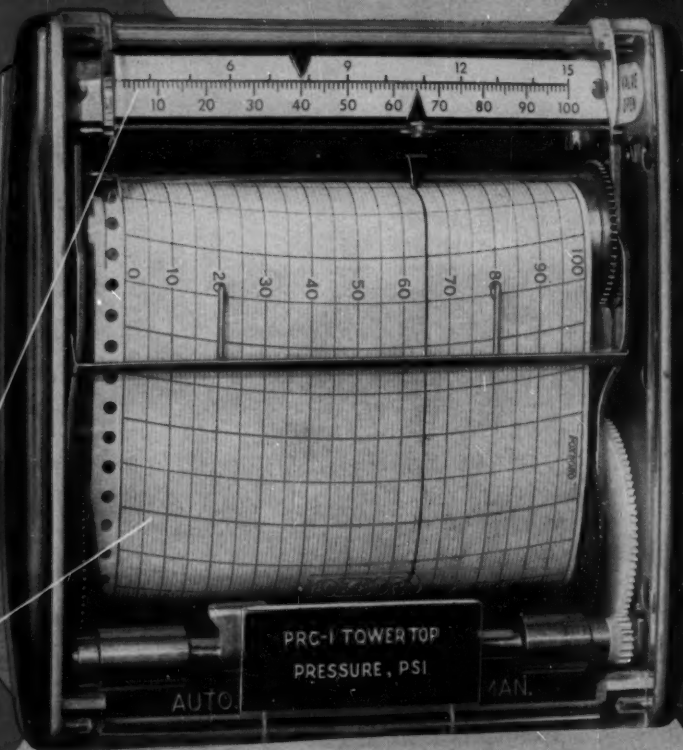
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compactness with nothing sacrificed!

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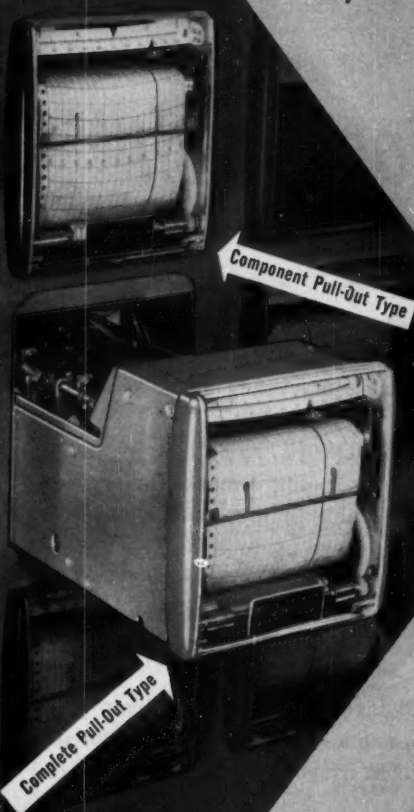
In all the following CONSOTROL instruments, recorder and indicator units can be easily converted in field.

- Recording Control Station with automatic/manual transfer
- Recording Control Station with manual loading only

- Recorder — single or two pen
- Indicating Control Station with automatic/manual transfer
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CONSOTROL

small-case
panel instruments



Here's the "tops" in centralized recording and control efficiency! CONSOTROL* Instruments require the minimum of valuable panel space, yet provide unsurpassed operator convenience, visual accuracy, and ease of maintenance . . . maintain the highest standards of precision and dependability. For example: the simple CONSOTROL method of switching from automatic to manual control requires no memory or extra operations . . . never "bumps" the process. All CONSOTROL charts and scales are full 4-inch width for greatest visibility . . . highest accuracy. When it comes to servicing, there's plenty of "finger room" . . . all parts are uncrowded and easily removable. And just compare inking requirements with other designs.

CONSOTROL needs ink filling only once or twice a year!

These are only a few of CONSOTROL's advanced design features — available in both fixed-mounting and full pull-out type instruments. Get the complete story. Write for Bulletin 13-18. The Foxboro Company, 364 Neponset Avenue, Foxboro, Mass., U.S.A.

*Reg. U.S. Pat. Off.

FOXBORO

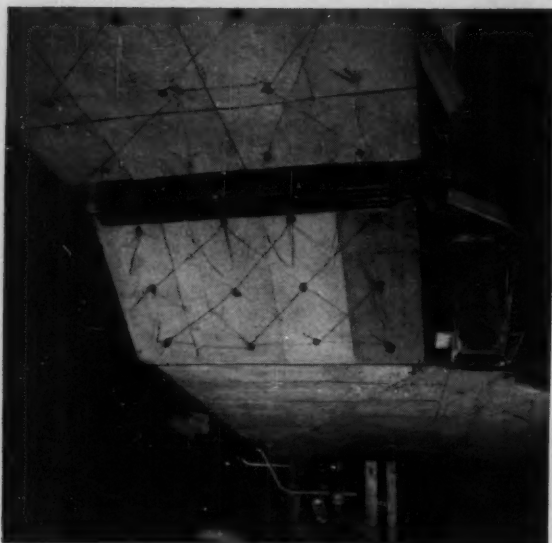
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Consotrol Process Control

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

EAGLE-PICHER PV SUPERTEMP BLOCK INSULATION

with the NEW *"Precision-Finish"*



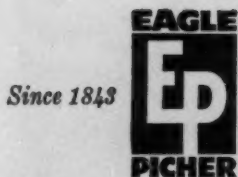
A TRUE-CUT BLOCK! Eagle-Picher's new "precision-finish" is one of the most important insulation developments in years. Here's a highly efficient, all-purpose insulating block that is practically dustless.

GREAT STRUCTURAL STRENGTH! Eagle-Picher PV Supertemp Block meets your specific demands for long-lasting insulating block able to withstand a wide hot surface temperature range up to 1900 F. PV Block effectively resists steam and other moisture, does not disintegrate or lose thermal efficiency under heavy-duty service.

EASILY INSTALLED! Lightweight PV Supertemp Block is easy to handle, requires only minimum reinforcing. It is easily cut to fit irregular areas—and no special tools are needed.

WRITE FOR FREE SAMPLE TODAY!

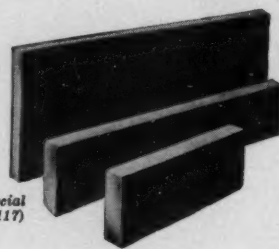
Compare Eagle-Picher PV Supertemp Block with other insulating blocks. You'll appreciate the improved temperature control that pays off in greater fuel savings. You'll sell yourself on the new "precision-finish"!



THE EAGLE-PICHER COMPANY

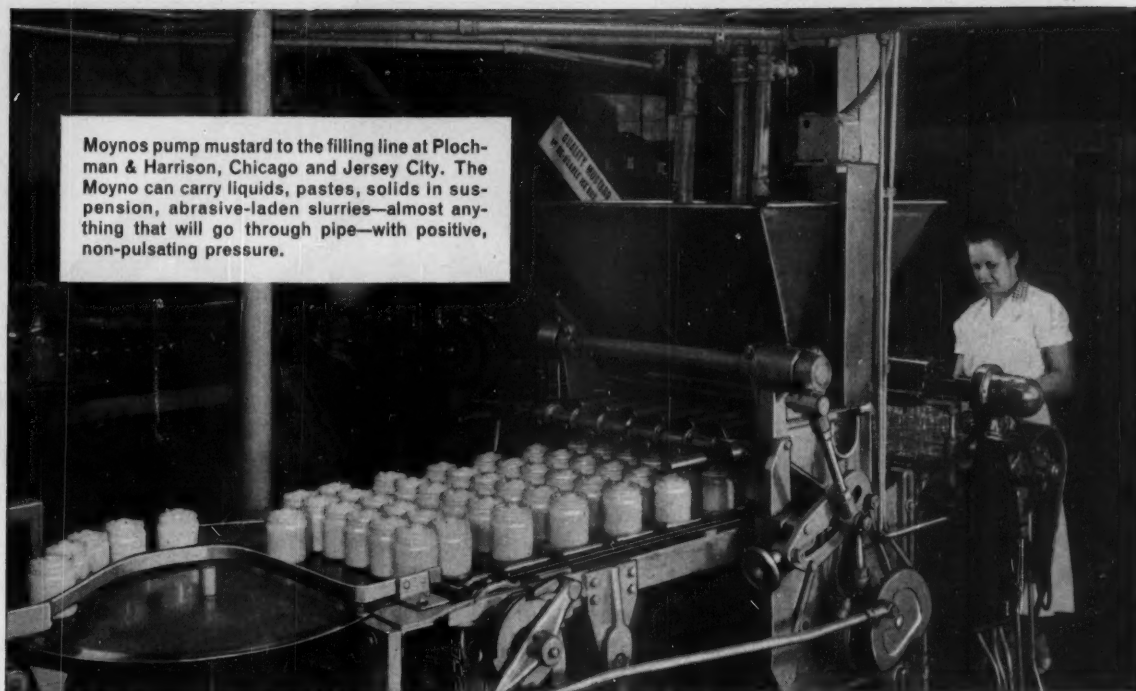
Producing a complete line of industrial insulations
Cincinnati 1, Ohio

(Member of Industrial Mineral Fiber Institute)



*(Conforms to Commercial
Standard CS 117)*

Moynos pump mustard to the filling line at Plochman & Harrison, Chicago and Jersey City. The Moyno can carry liquids, pastes, solids in suspension, abrasive-laden slurries—almost anything that will go through pipe—with positive, non-pulsating pressure.



Mustard Mill Changes to MOYNO® Pumps to Get Positive Displacement, Longer Pump Life

A Moyno Pump installation at Plochman & Harrison, makers of the famous Premium Brand Mustard, illustrates the outstanding performance of the Moyno Pump. They have been pumping mustard to a filling line with the Moyno for over two years without a single replacement of parts. They are replacing other pumps with Moynos.

The mustard is pumped as a semi-solid. In addition, it has both an acid and an abrasive content which causes other pumps to wear out in a few months. Moynos handle a wide variety of products that are not pumpable with other types of pumps. These include potato salad, chow mein, fruit, acid, alkalis, pastes, abrasive slurries, paints, tar, cement, plaster, many others.

The Moyno has a unique rotor and stator arrangement which forms sealed progressing cavities that move the material, providing positive displacement. For this mustard handling job parts were made of stainless steel to assure trouble-free service and long pump life. Rotor and stator are available in other alloys, or plastic compositions.

Note the outstanding features of the Moyno shown at the right. Perhaps your pumping problems can be solved with the Moyno. Write us today! Ask for a free copy of Bulletin CE. It will give you complete facts!

Features of the MOYNO that may solve YOUR pumping problem

Gentle: no churning; won't break up semi-solids . . . won't aerate liquids. May be used for metering.



Reversible: pumps with equal efficiency in either direction.

Trouble Free:

self priming; won't cavitate or vapor-lock. Just one moving part—no valves to stick, no pistons to gum up. Built for tough service. Easy to maintain.

Positive Displacement:

Moynos are available to pull up to a 29" vacuum while discharging under pressure. Big Moynos deliver up to 500 g.p.m. Pressures to 600 p.s.i. plus are available.

ROBBINS & MYERS, INC.

SPRINGFIELD, OHIO • BRANTFORD, ONTARIO



Fractional and Integral HP Motors



Household Fans



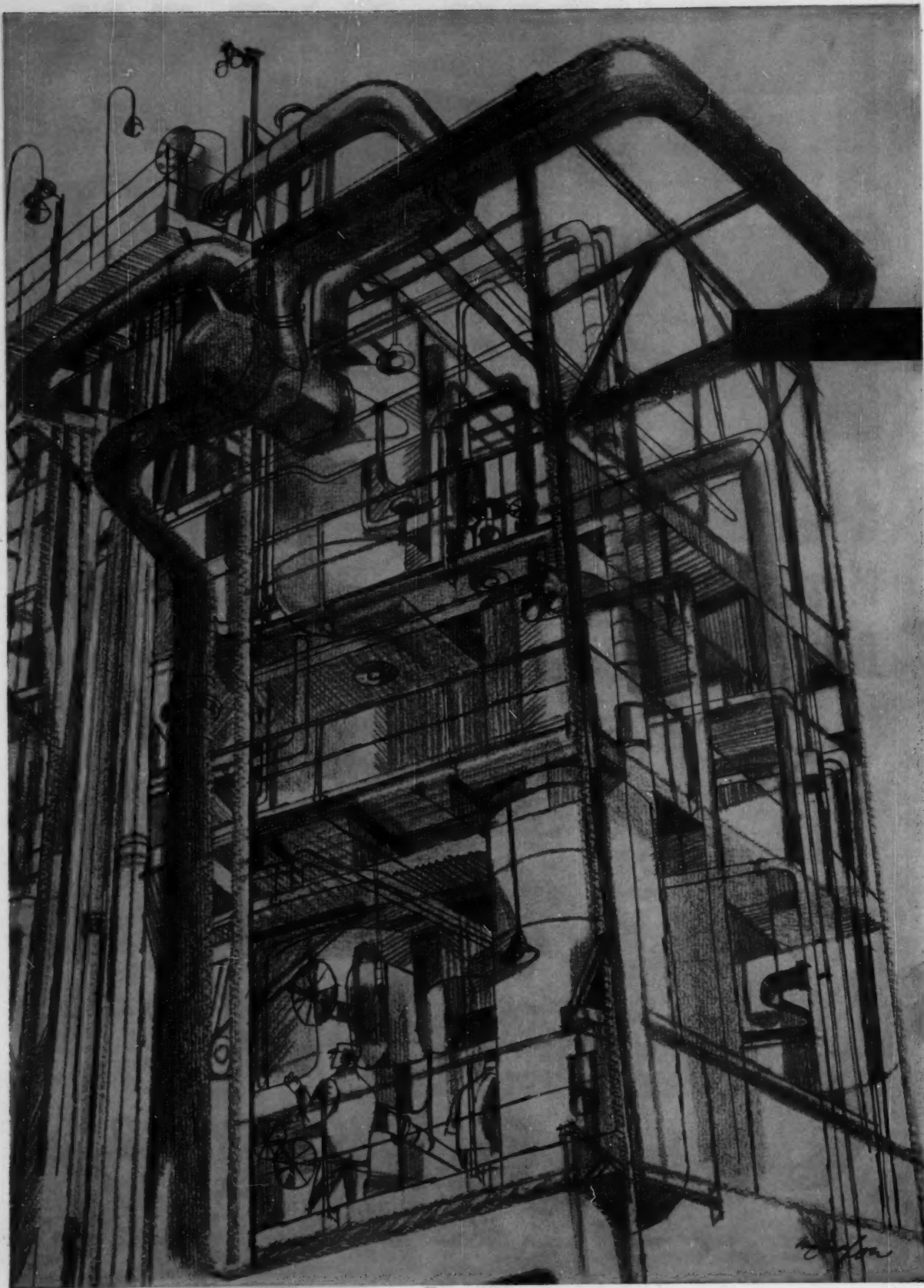
Hoists and Cranes



Large and Small Moyno Pumps



Propeller Industrial Ventilating Equipment



2-system fractionation

— used exclusively by Armour,
now gives you highest
purity fatty acids of
guaranteed composition!

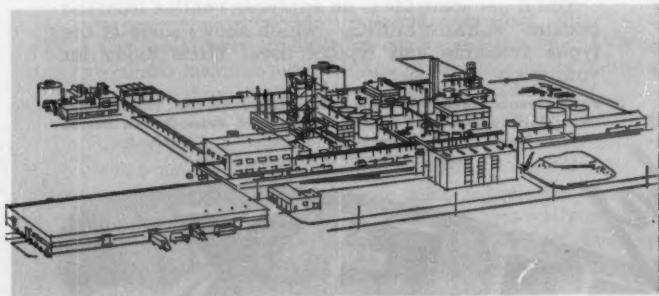
Uniformity in the fatty acids you purchase can spell the difference between profit and loss for your company. You need fatty acids possessing specific characteristics and composition. And, you must be sure that every shipment will have *exactly* the same characteristics and composition. Now, the production from Armour's exclusive 2-system fractionation provides the answer to both problems. Armour's modern plant uses fractional distillation to separate fatty acids through difference in boiling points, and solvent crystallization to separate acids through difference in degree of unsaturation. Because this wide variety of acids is produced under strict laboratory control and rigidly enforced specifications, Armour is able to offer Neo-Fat® fatty acids of *guaranteed composition!*

The consistent composition of Armour Neo-Fats means greater uniformity in your processing. It also means increased standardization of your op-

erating procedures and increased control of production resulting in more uniform quality end products. In shipment after shipment, you'll find Armour Neo-Fats will not vary in specified properties, or composition.

2-system fractionation makes it possible for you to order tank-car quantities of Neo-Fats offering single components in purities as high as 96%—highest in the industry. Thus, you can obtain the specific fatty acid you need free of other acids that detract from the quality of your formulations. We produce saturated fatty acids from 8 carbon chain lengths through 18, as well as various unsaturated acids. This is the most versatile and complete line of highest purity fatty acids available.

Order by specification or by composition. Send the coupon now for further information about Armour Neo-Fat Fatty Acids—and how they can improve your profit margins.



The modern Armour plant at McCook, Illinois



ARMOUR
CHEMICAL
DIVISION

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ARMOUR CHEMICAL DIVISION
1355 West 31st Street, Chicago 9, Illinois

Please send me:

- ☐ New 48 page brochure, "The Chemistry of Fatty Acids."
- ☐ New Specification Chart of the complete line of Neo-Fat Fatty Acids.

Name

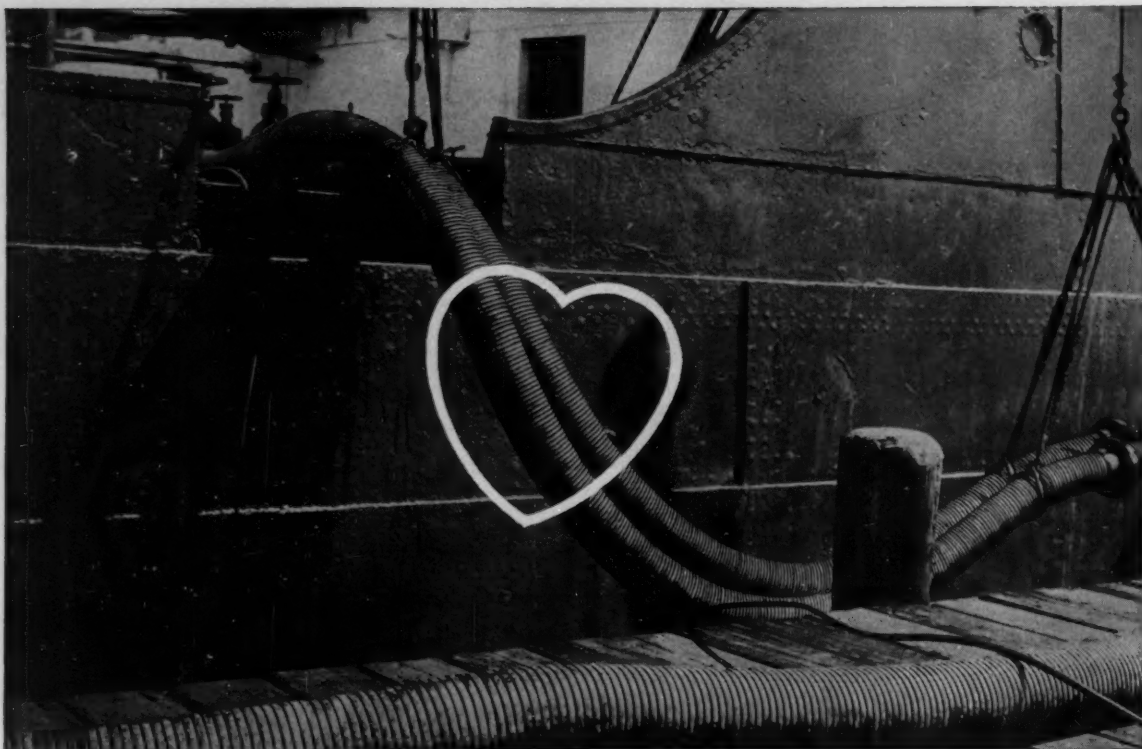
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City Zone State

CH 4



BLACK GOLD, BLACKSTRAP OR BLACK DIAMONDS ...PENFLEX MOVES IT, AFLOAT OR ASHORE

Whether cargo is a reasonably heavy liquid like crude oil . . . tacky like blackstrap molasses . . . semi-solid like asphalt . . . a granular solid like coal . . . it finds smooth passage through Penflex tubing. It can be non-combustible or highly volatile . . . Penflex leak-proof construction makes any transfer safe.

Being flexible, Penflex tubing "gives" . . . rides with the tide in ship unloading . . . simplifies transfer from railroad cars and tank trucks . . . enables stationary tanks to settle or "move" with temperature changes, without breaking their connecting transfer lines.

It's rugged too . . . outlasts by far any solid piping

or other types of hose in moving abrasive solids like coal, sand or copra.

These combined features give Penflex numerous applications . . . as air intake or exhaust lines on Diesels and compressors, expansion joints on steam lines, piping for gases, water and all kinds of fuel and lube oils.

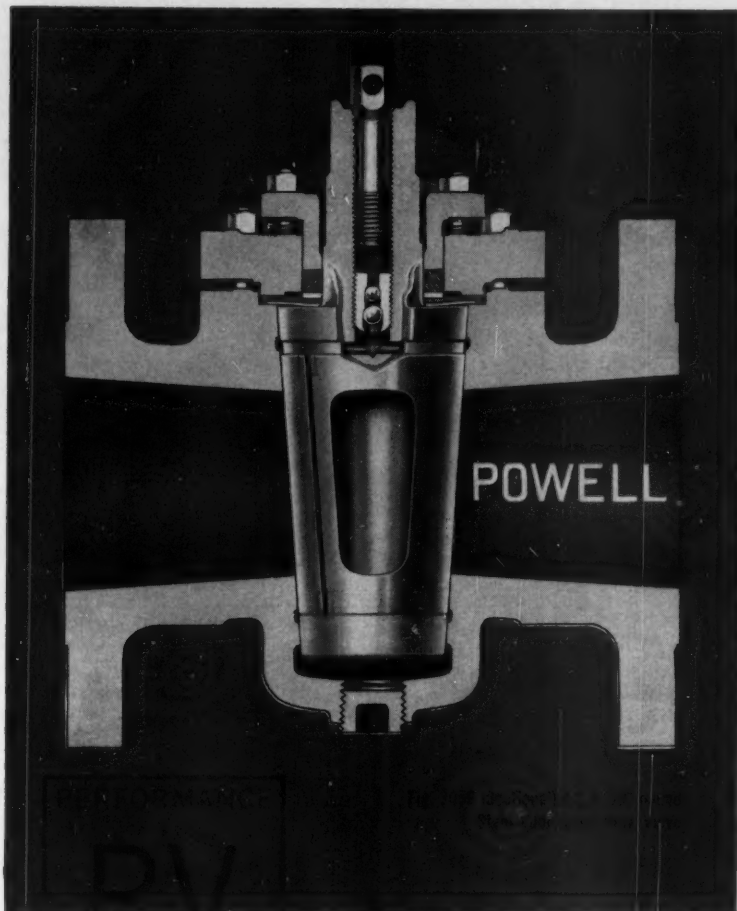
You'll get some ideas on applying Penflex from the booklet "FLEXINEERING," which shows some of the types available and typical uses. Write today for your copy.

Pennsylvania Flexible Metallic Tubing Company, Inc., 7234 Powers Lane, Philadelphia 42, Penna. • Branch Sales Offices: Boston New York • Chicago • Houston • Cleveland and Distributors in Principal Cities



FLEXIBLE TUBING, AUTOMATIC BARREL FILLERS, PNEUMATIC RIVET PASSERS, ACCESSORIES AND FITTINGS

Powell Lubricated Plug Valves



PERFORMANCE
PV
VERIFIED

Powell Lubricated Plug Valves maintain the 110-year tradition of quality and precision. Only the finest available materials are used. And painstaking quality control is rigidly enforced through each and every step of manufacture.

Valve users who want one source of supply for lubricated plug as well as all types of bronze, iron, steel and corrosion-resistant valves will want full details on Powell Lubricated Plug Valves.

For example, features include quick and positive operation—just a quarter-turn to open or close. Lubricant grooves surrounding each port provide a positive seal when the valve is closed. In an open position, seating surfaces are not exposed. Available in Steel and Semi-Steel through distributors in principal cities.

For full details, write for the new PV-4 Catalog on Powell Lubricated Plug Valves. Just fill out the coupon and mail. Of course there's no charge, no obligation.

The source of supply for all valve needs!

POWELL VALVES ...110th YEAR

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES.

CHEMICAL ENGINEERING—April 1956

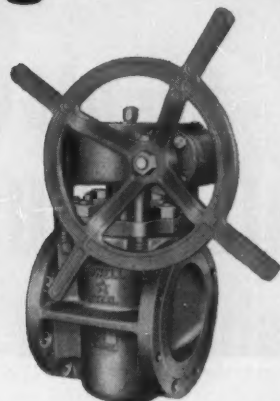


FIG. 1559G—150-pound Steel Lubricated Plug Valve. Gear operated



FIG. 2200—175-pound W.O.G. Semi-Steel Lubricated Plug Valve

THE WM. POWELL COMPANY
2525 Spring Grove Ave.
Cincinnati 22, Ohio

Gentlemen:

Please send me a copy of your PV-4 Catalog on Powell Lubricated Plug Valves. It is understood that there is no cost, no obligation.

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title _____

company _____

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zone _____ state _____

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Serves The OIL INDUSTRY Ashore and Afloat

*Loading of a 171-ton Bubble Tower
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▲ *Constructing Gas Compressor, Tank Battery and Drilling Barges at Beaumont.*

New Construction: Drilling Barges and Tenders. Compressor, Deck, Oil, Supply and Tank Battery Barges. Fixed and Mobile Platforms. Propane, Anhydrous Ammonia, Caustic Soda, Molten Sulphur and Gasoline Barges. Tankers. Freighters.

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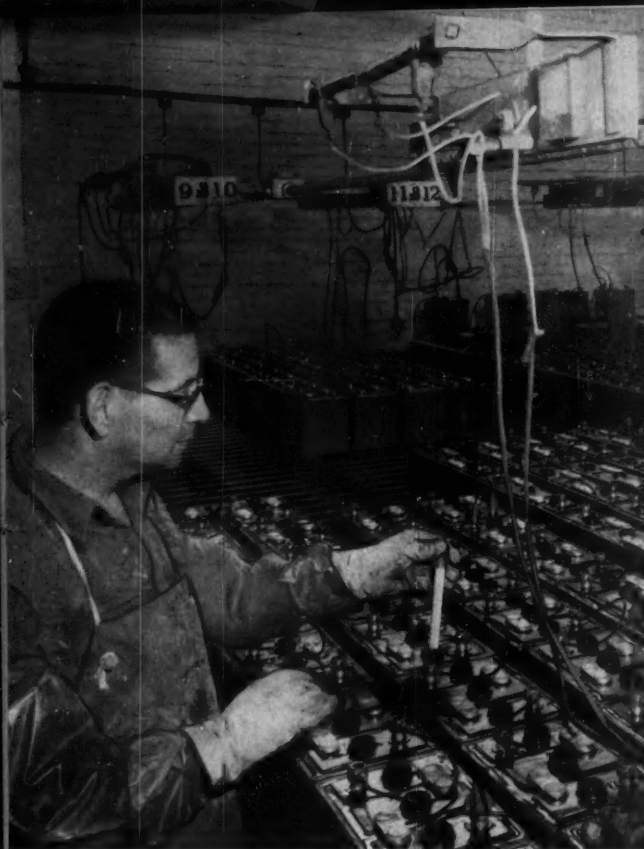
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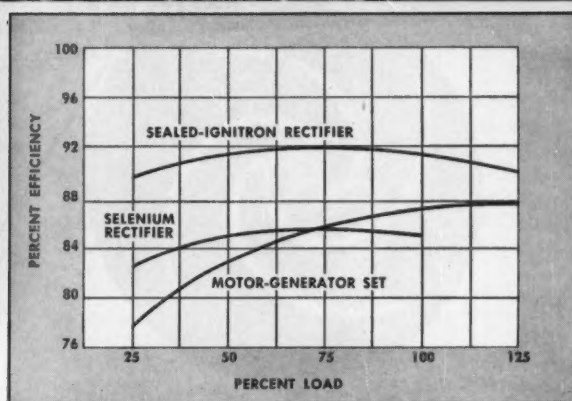
GENERAL OFFICES: 25 BROADWAY, NEW YORK 4, N. Y.

On the Pacific Coast shipbuilding and ship repairing are performed by the Shipbuilding Division of Bethlehem Pacific Coast Steel Corporation





KEY TO LOW COST D-C POWER is uniformly high efficiency of G-E sealed-tube rectifiers shown at right. Workman above is checking charging rate of part of day's output.



Westric Battery Co. reports... "power costs down, production up with G-E sealed-tube rectifiers"



MINIMUM ATTENTION required by G-E sealed-tube rectifiers has impressed both Lee Hill, President (r) and Ed Hilliard, Vice President, Westric Battery Co.

Over a year ago the Westric Battery Company of Denver, Colorado, replaced its rotating d-c conversion equipment with a General Electric 150-kw d-c unit substation... a co-ordinated equipment including an efficient mercury-arc rectifier with sealed ignitron tubes and associated transformer and switchgear.

Lee Hill, President, now reports: "We find that this G-E sealed-tube rectifier is paying for itself in savings on power costs... and in increased production. High efficiency is the most important factor, but the fact that it requires almost no maintenance or attention by operating personnel is also very important. And its consistent operation with excellent voltage regulation has made possible an increase in both the quantity and quality of our output of some 1000 lead-acid batteries a day."

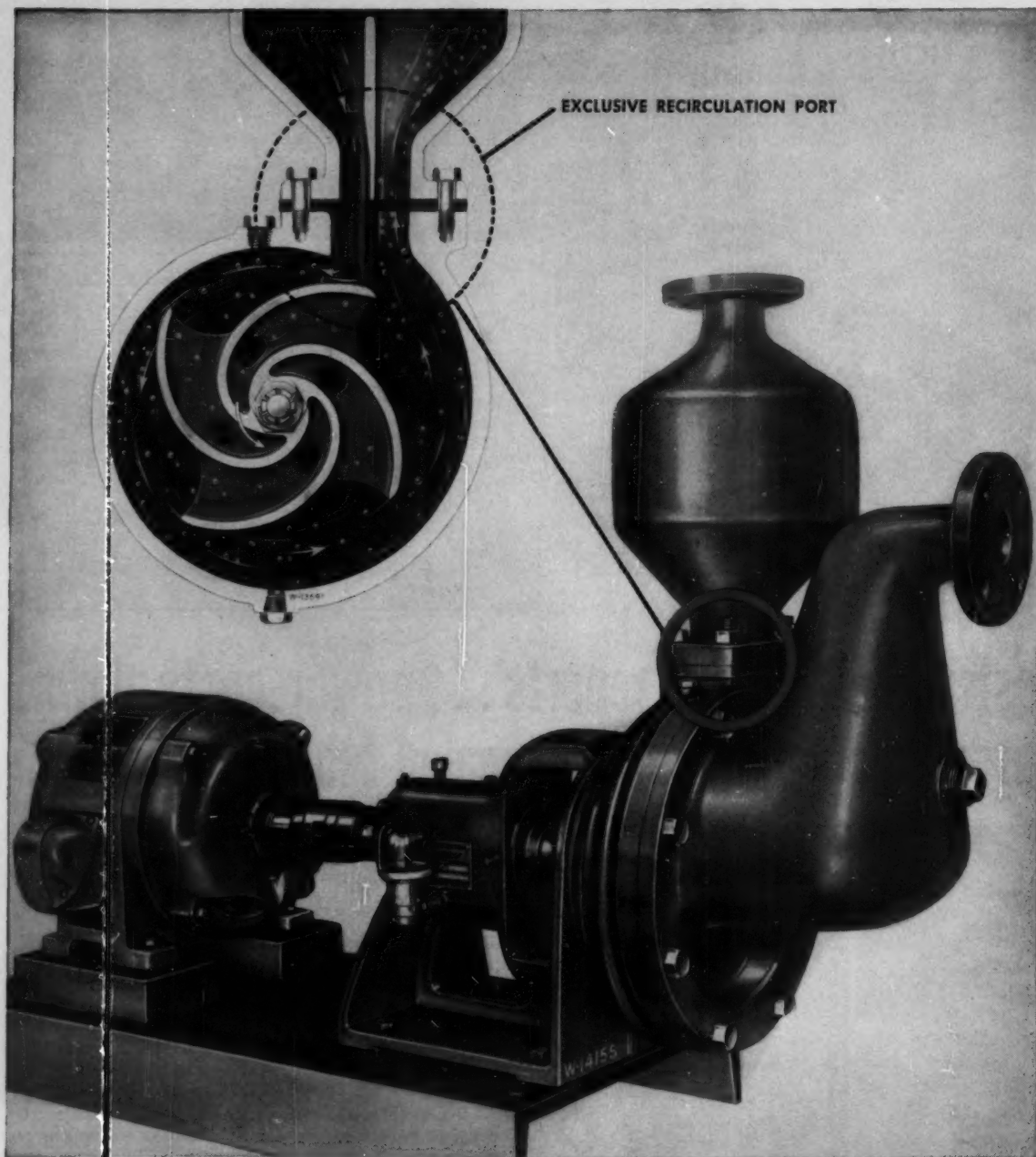
FOR YOUR D-C APPLICATIONS, too, G-E mercury-arc rectifiers can provide similar advantages. Thousands of users have found them the most economical source of d-c power for machine tools, steel mill and printing press drives, electrochemical processes, elevators, cranes, etc. For complete details, see your nearest G-E Apparatus Sales Representative. General Electric Company, Schenectady 5, New York.

524-4

Progress Is Our Most Important Product

GENERAL  ELECTRIC

NEW! Self-priming Worthite*



NEW WORTHINGTON SELF-PRIMING PUMP with motor and base. Three standard sizes fit this versatile pump to a variety of capacity and head requirements.

As shown in cutaway, impeller mixes liquid trapped in suction chamber with vapor or air from suction and forces mixture into recirculation chamber. Vapor

leaves by discharge pipe, while vapor-free liquid falls back through recirculation port (red) for remixture with vapor. Process continues until pump is primed. Easy replacement of recirculation port permits use of variety of impeller sizes and maintenance of critical clearance between impeller and port.

* Worthington's super-stainless corrosion resisting alloy steel.

centrifugal chemical pump

Features wider coverage in capacity and head than any similar pump in the chemical industry

Three pump sizes, plus exclusive Worthington removable RECIRCULATION PORT, plus a variety of different impeller diameters for each pump, make this new pump the most versatile self-priming corrosion resistant pump available.

It's the Worthington type CNGK. Part of the Worthington SESC line, this new pump is recommended for chemical sump pumping, tank-car unloading, or any application where both liquid and vapor handling capacity is required.

Key to the CNGK's flexibility (see photo at left) is the exclusive new Worthington removable recirculation port. Here's what the removable recirculation port gives you:

1. Wider coverage without the use of belt drive. In each pump size, impeller diameter can be cut down with very little change in priming time. Various combinations of impeller diameters, and recirculation port lengths are available for each pump. This means that the close clearance required between impeller and recirculation port can be maintained regardless of impeller diameter.

2. Renewable clearance at tongue. Removable recirculation port allows replacement of this part in those

services where severe wear may be encountered. This feature enables the pump user to renew a critical clearance with a small repair part.

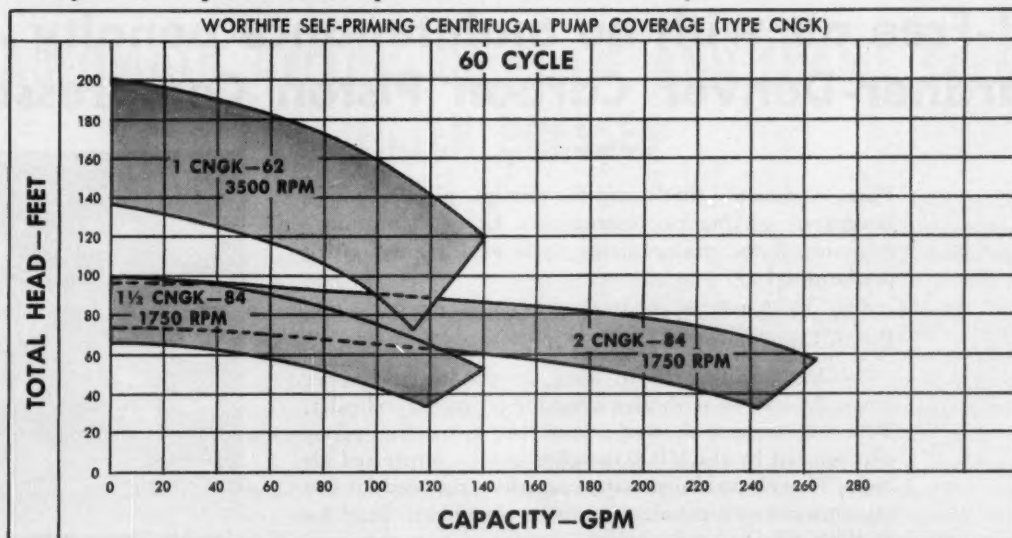
3. Smaller, lighter pump with faster prime. The recirculation port is designed for maximum recirculation velocity. This cuts down the volume of liquid required to transfer a given amount of air or vapor from the suction to the discharge pipe and allows smaller volume for suction and discharge chambers than in other designs.

4. Versatility is further carried out since these pumps are designed for both packed stuffing box or mechanical seal operation. Worthington's type EA mechanical seal, proven over many years of operation in the Chemical Industry, is available on the type CNGK pumps. The pump and mechanical seal are an integrated design, and all parts of the mechanical seal are as corrosion-resistant as the pump itself.

Remember—the CNGK is part of the standard SESC pump line. Minimum use of special parts means lower initial costs and easier, faster servicing.

For complete data on this latest Worthington standard chemical pump, write today for bulletin W-350-B-13. Worthington Corporation, Section PC.5.39, Harrison, New Jersey.

PC.539



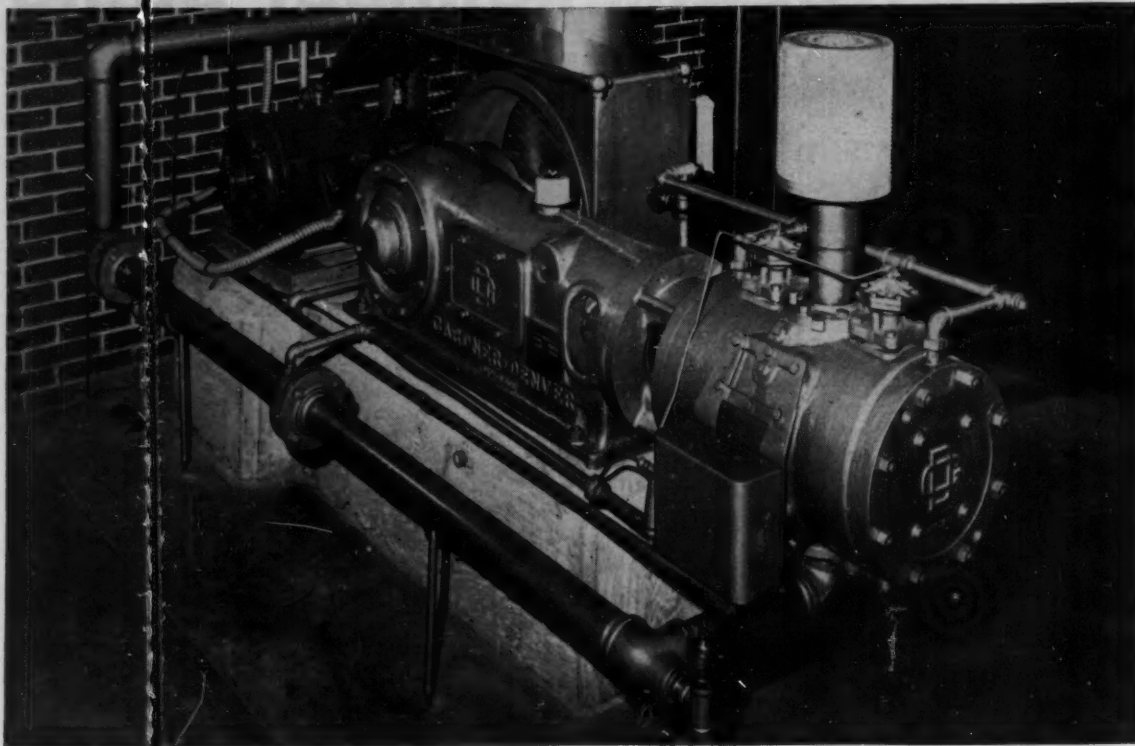
WIDER HYDRAULIC COVERAGE than for any other self-priming centrifugal chemical pump is provided by the new

CNGK. Chart shows coverage for 60-cycle motor speeds (50-cycle ratings on request).

WORTHINGTON



Gardner Denver . . . Serving the World's Basic Industries

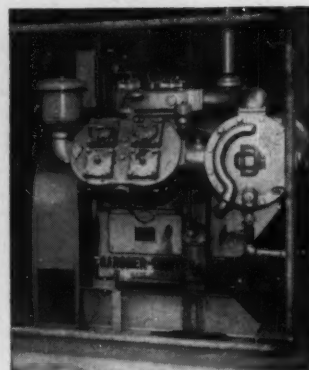


Oil-Free air with no maintenance penalty . . . Gardner-Denver Carbon Piston Compressors

Pure, oil-free air that's safe for textiles, plastics, foods, beverages, automation instruments. Low-cost air that's economical for maintenance tools and regular plant operation.

You get both from the Gardner-Denver CRX Carbon Piston Compressor.

Self-lubricating carbon, used for pistons and other parts, does away with any need for oil in the cylinder. Yet, user reports show that cost per cubic foot of air compressed by the CRX matches usual compressed air costs. There's no maintenance penalty—no need for two separate compressed air systems in your plant. Send for Bulletin CRC-10 today.



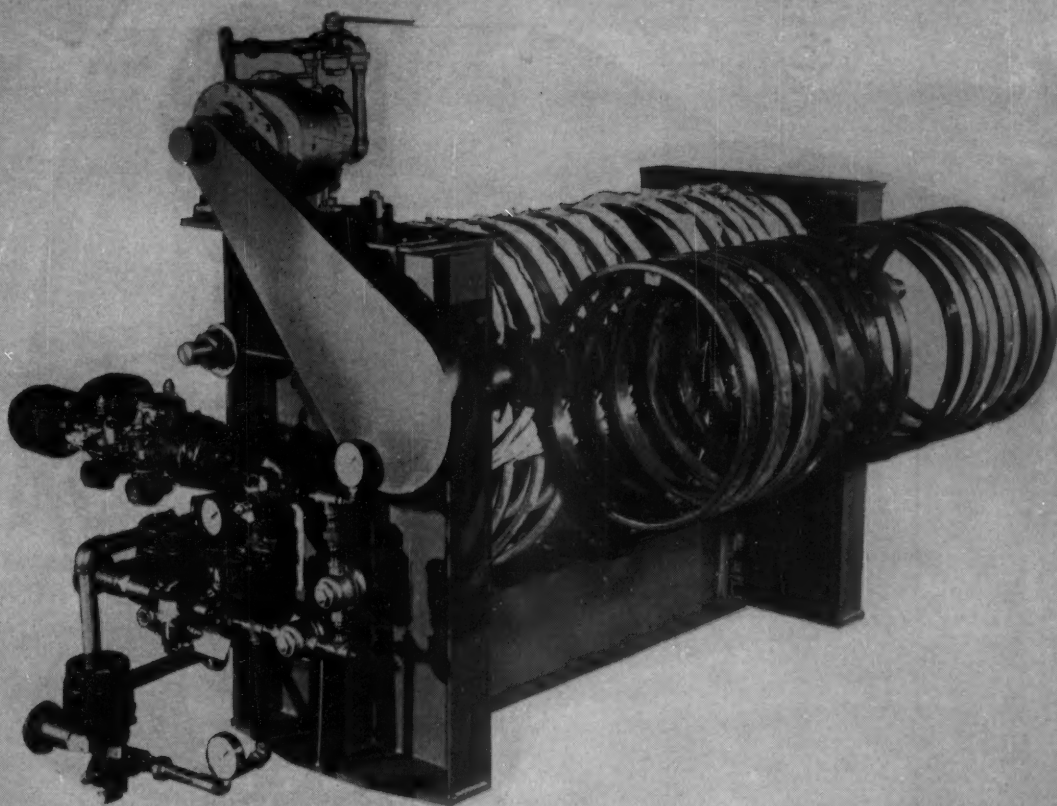
Another popular industrial compressor . . . the compact, efficient Gardner-Denver WB.



GARDNER - DENVER

THE QUALITY LEADER IN COMPRESSORS, PUMPS, ROCK DRILLS AND AIR TOOLS
FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario



AUTOMATIC CYCLING OF PLATE AND FRAME TYPE FILTER PRESSES

Automatic, practically continuous, filtration is now available in a plate and frame type of filter with the Eimco-Burwell Filter.

This filter developed to give a high rate of filtration on difficult, hard to filter, slurries where the particle size is measured in microns and where the filtrate must be brilliantly clear, has been used on slurries previously believed unfilterable on any automatic or semi-automatic filter.

These Eimco-Burwell filters have in many cases improved the conditions in the plant by: (1) producing a clearer filtrate, (2) increasing the capac-

ity of the filter station on amount filtered per square foot of filter area per hour. (3) Reducing to practically zero the shut down time required for cleaning. (4) Increasing media life per ton of production. (5) Reducing the operator's physical labor. (6) Washing out more of the soluble values. (7) Upgrading the concentrate to a more salable product, and in many other ways increasing the general plant efficiency.

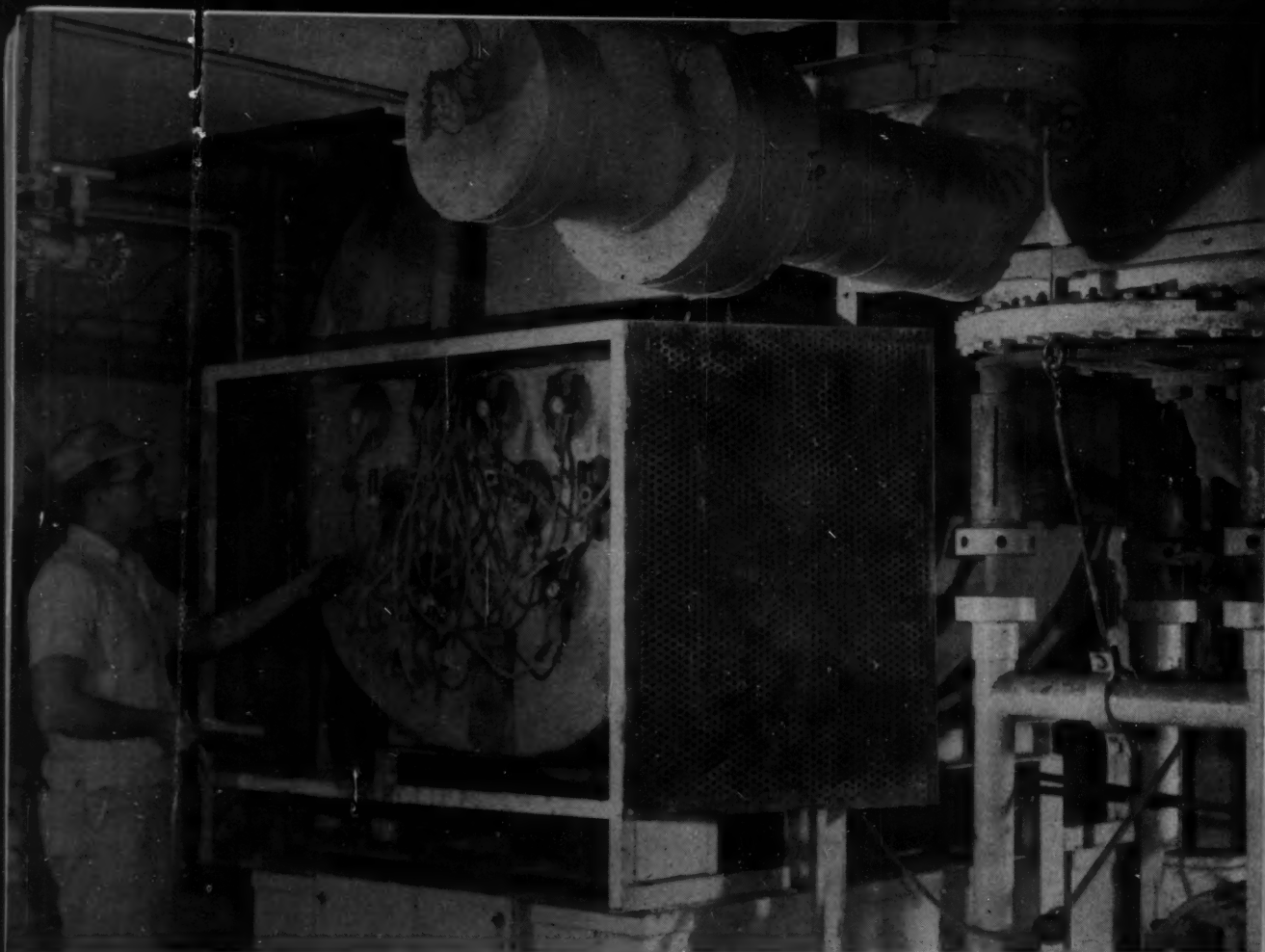
Let Eimco provide you with data on filtration of products similar to your own on an Eimco Filter designed to specifically handle that material.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Pasadena, Calif. Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

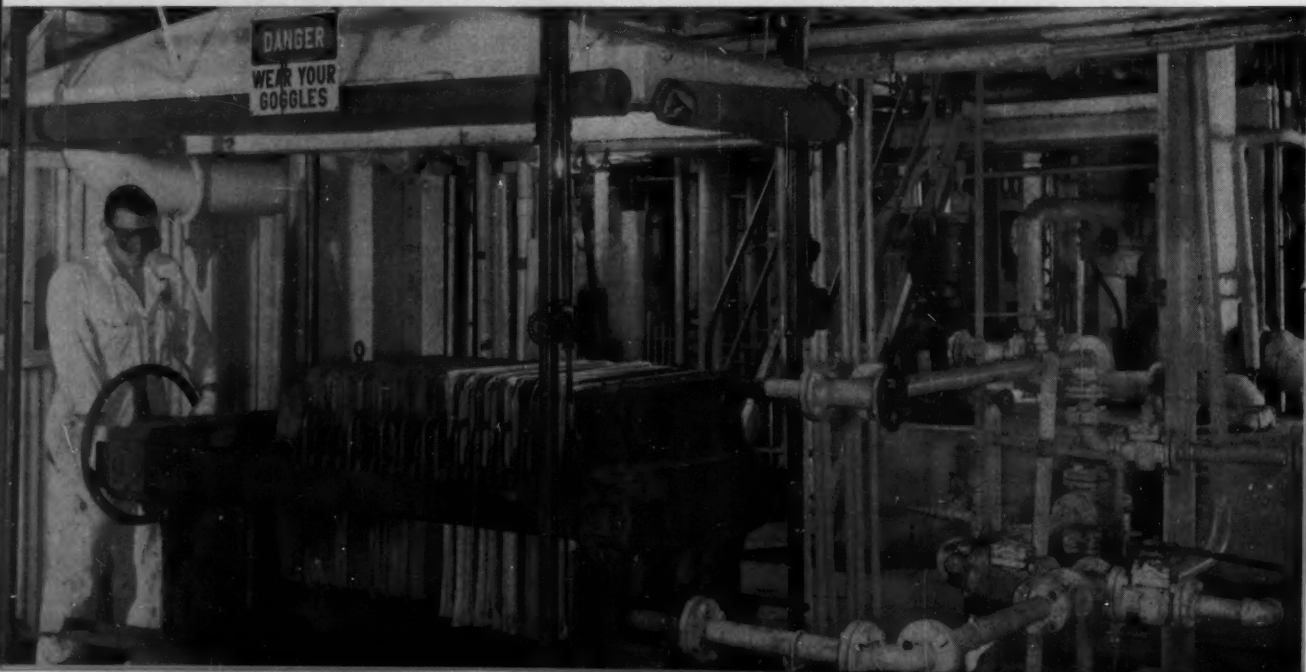


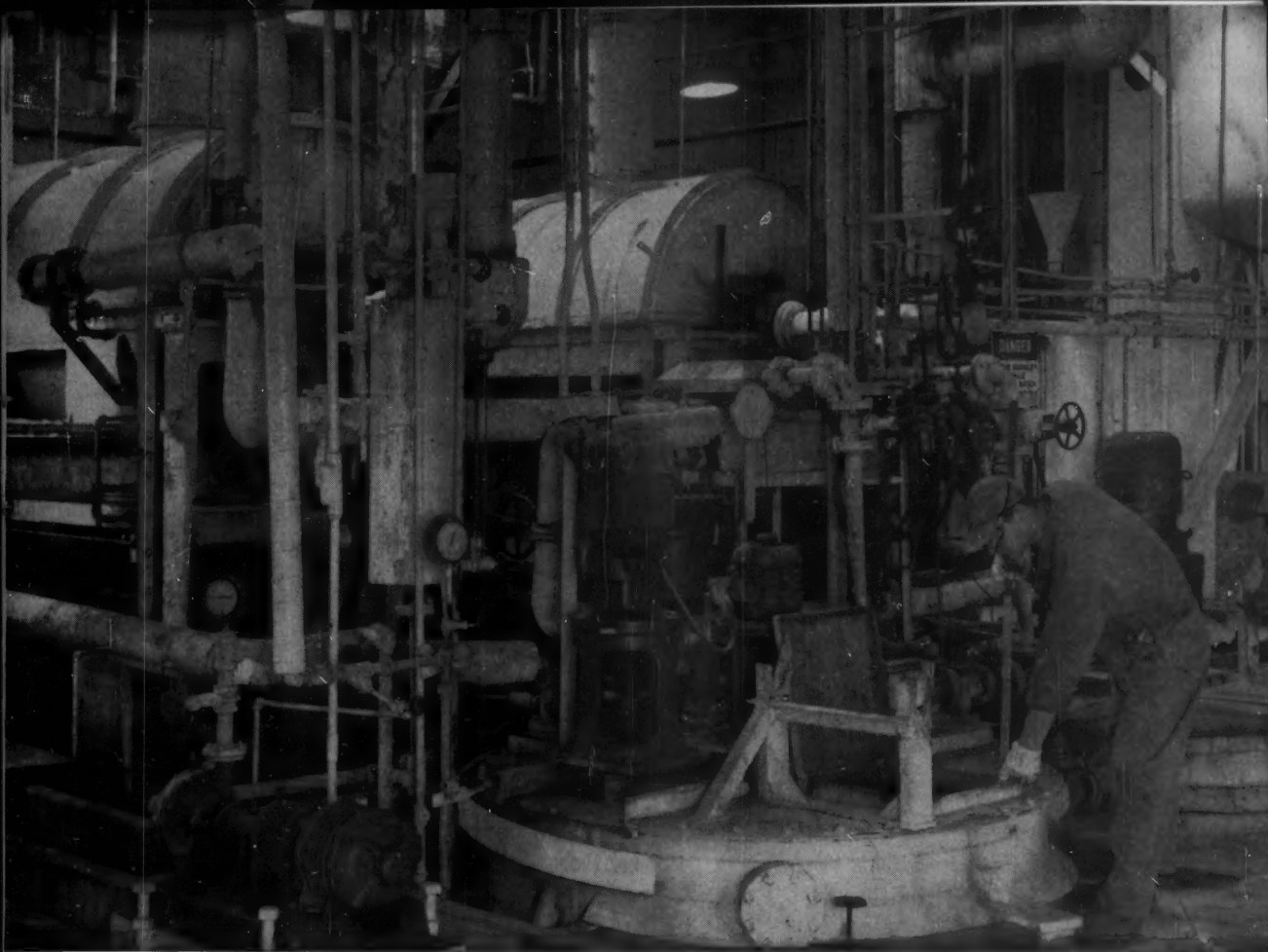


PRE-HEATED SULFUR is combined with pre-heated hydrogen in Stainless Steel catalyst chamber to form hydrogen sulfide gas.

HOW STAINLESS STEEL

SODIUM SULFHYDRATE comes through Stainless tubing into this Stainless filter press and is pumped into Stainless weigh tanks.





AFTER FILTRATION, the solution is pumped to these flaker feed tanks, equipped with Stainless pumps, agitators and piping.

UPHOLDS PURITY in sodium sulfide production

AT HOOKER ELECTROCHEMICAL COMPANY, NIAGARA FALLS, N.Y.

Hooker Electrochemical Company, Niagara Falls, N.Y., is a major factor in the marketing of sodium sulfide in the United States; and the firm goes to extraordinary lengths to protect its market by maintaining the highest standards of purity.

Almost automatically, this means the generous use of Stainless Steel where there is the slightest danger of contamination, resulting from corrosion. Stainless Steel serves in the sulfur boiler, pipelines, condensers, separators, filter presses, pumps, flakers and agitators.

Besides guarding purity, Stainless Steel often simplifies design. The agitators, for instance, could be made much larger, because the strength of Stainless permits it to operate at such a high stress level. Hooker had no trouble fabricating their Stainless equipment; in fact, it was practically all done locally.

To guard purity, resist corrosion, withstand high stresses and temperatures, nothing can equal Stainless Steel for chemical equipment. To be sure of service-tested quality, specify USS Stainless Steel.

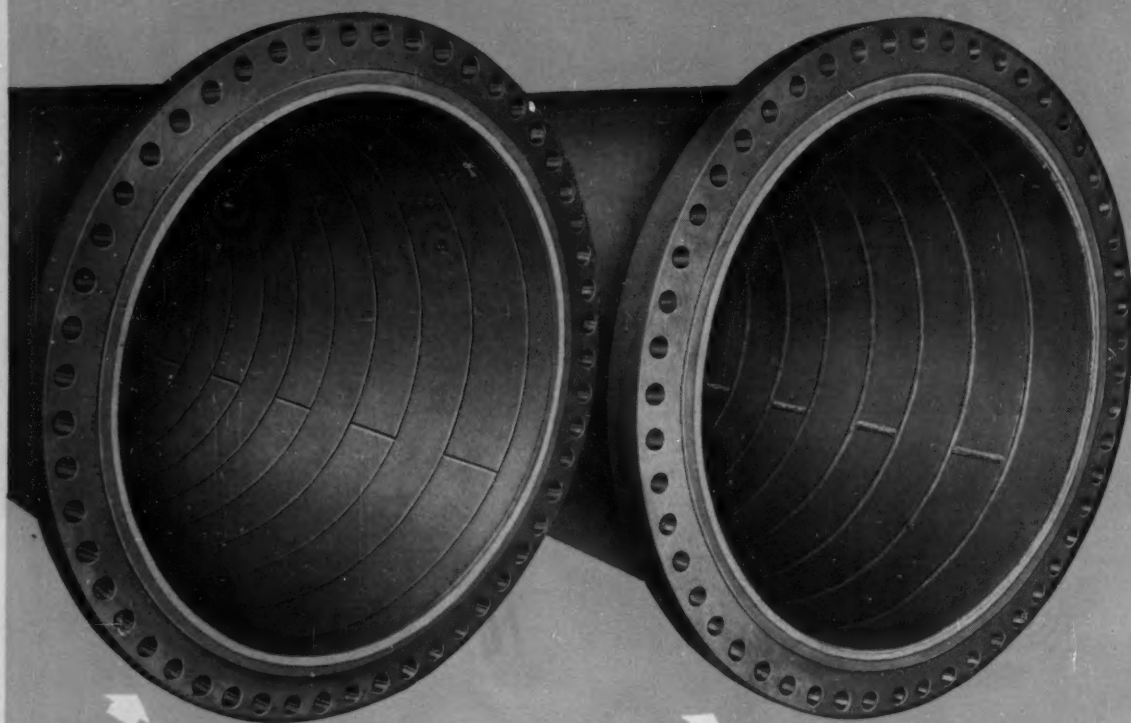
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USS STAINLESS STEEL

SHEETS • STRIP • PLATES • BARS • BILLETS • PIPE • TUBES • WIRE • SPECIAL SECTIONS



UNITED STATES STEEL



Lining Fitted—Before Welding

Vessel Completely Lined—After Welding

For Special *Lined* Processing Vessels

Come to STRUTHERS WELLS

LINING processing vessels of all kinds for chemical plants and refineries is another service in which Struthers Wells specializes. Years of engineering experience and extensive fabricating facilities enable us to build lined vessels that meet all codes and requirements.

The vessel illustrated is Inconel-lined,

36" I.D. x 43' high. Working pressure is 600 lbs. Lining is welded to outer wall to become an integral part of the processing vessel.

Vessels can be furnished lined with titanium, stainless steel, nickel, silver, hastelloy and other weldable metals to suit your applications.

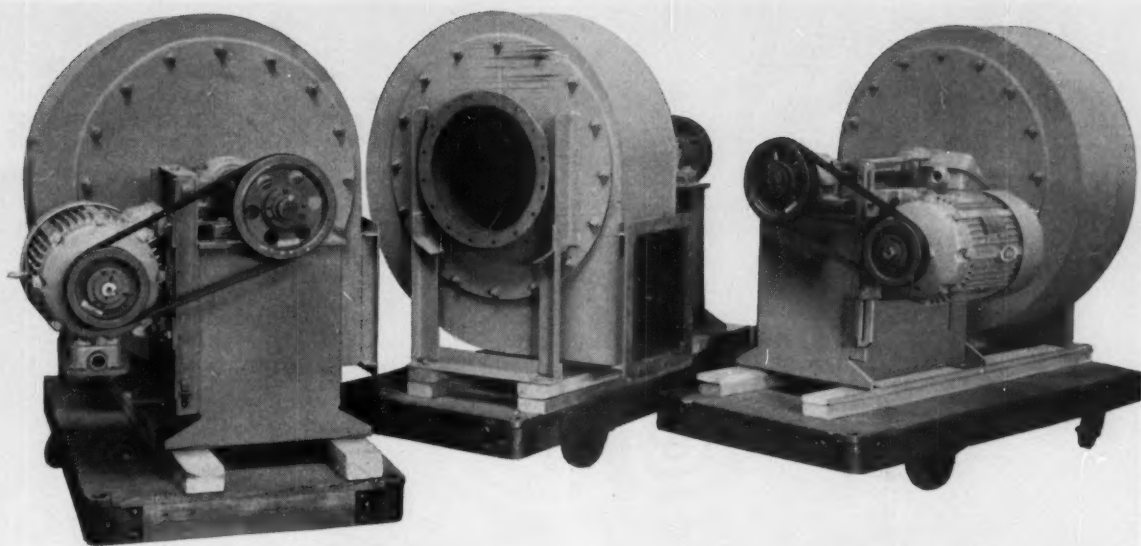


STRUTHERS WELLS CORPORATION

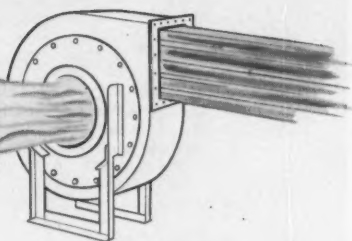
TITUSVILLE, PA.

Plants at Titusville, Pa. and Warren, Pa.

Offices in Principal Cities



EXHAUSTING CORROSIVE FUMES

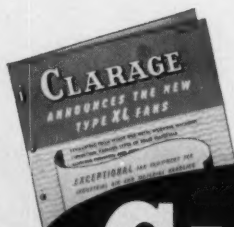


no problem for Clarage rubber-lined fans

Clarage's **distinctively** heavy-duty construction, plus the added advantage of special coatings, add up to far longer service life. Important savings for you!

The Clarage fans above are now serving as leach tank exhausters, handling fumes from a concentrated brine solution containing up to 5% hydrochloric acid. In this case, all interior fan parts are protected by a layer of rubber vulcanized to the metal. For other extra-severe applications Clarage fans can be treated with other special coatings, lead lined, or built of special construction.

If you're seeking fans that have what it takes — in every respect — call us in. CLARAGE FAN CO., Kalamazoo, Michigan.



Send for Bulletin 702-A

CLARAGE

...dependable equipment for making air your servant

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

CHEMICAL ENGINEERING—April 1956

A. O. Smith reports

Radiography is perhaps the most important inspection method A. O. Smith uses to detect flaws in welds and adjacent plate material. The products of A. O. Smith—ranging from critical ordnance and atomic energy equipment to pressure vessels and heat exchangers—require radiographic inspection of light gauge thickness and heavy wall thicknesses exceeding 6 inches. We make use of both x-ray and gamma-ray inspection and both methods depend on the density-variables characteristics of unexposed material. Technician is shown x-raying the longitudinal seam of an alloy-lined shell.

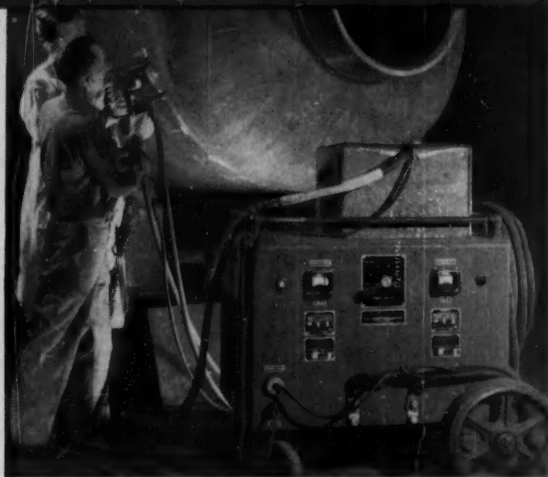
Skilful interpretation of the film is, of course, the key to successful radiographic inspection. If all the film developed and interpreted at A. O. Smith since 1932 were laid end to end, the strip would extend over 1,224 miles.



Important applications for nondestructive tests are those that determine acceptability of materials for specific corrosion-resistant or welding characteristics. Sulphur printing, illustrated here, is one of the central inspections used by A. O. Smith. The test is designed to determine the amount and segregation of sulphur present in forgings. This inspection evaluates the forging for welding.



on nondestructive testing



Still another method of flaw detection used by A. O. Smith is the magnetic particle test. Magnetic particle tests are ideal for detecting surface and sub-surface faults in ferrous materials. In this picture, technicians are shown inspecting the welds on a pressure vessel.



Ultrasonic testing (inspection utilizing high-speed sound waves) is another method A. O. Smith uses for quality control of heavy sections. The picture shows an additional application of ultrasonic testing — operator is determining wall thickness of 167,000-lb. vessel.

Nondestructive inspection is one more reason for the dependability of A. O. Smith vessels, exchangers and other process equipment.



The man in charge of A. O. Smith's nondestructive testing...

Mr. Carr, with A. O. Smith for more than 27 years, Mr. Carr has specialized in nondestructive testing since 1922. He has been a leading force in the development of many of the techniques and procedures now used throughout industry. He is past-president of the National Society for Non-destructive Testing... is serving on nondestructive testing committees of ASME and ASTM and in various other control groups. This experience is another reason why it's wise to call A. O. Smith first for processing equipment.

Illustrated here are just a few of the nondestructive testing processes by which A. O. Smith maintains the quality of its products. Of course, there are many other tests, too — both nondestructive and destructive — all designed to help create equipment that will excel in your operations.

A. O. Smith was one of the members of the original committee that first established radiographic inspection techniques and standards. Also, we have used magnetic particle testing since 1934... ultrasonic testing procedures since 1945.

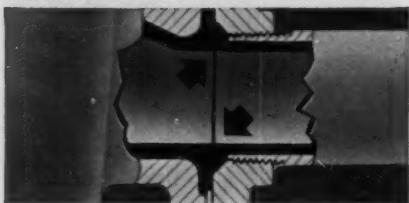
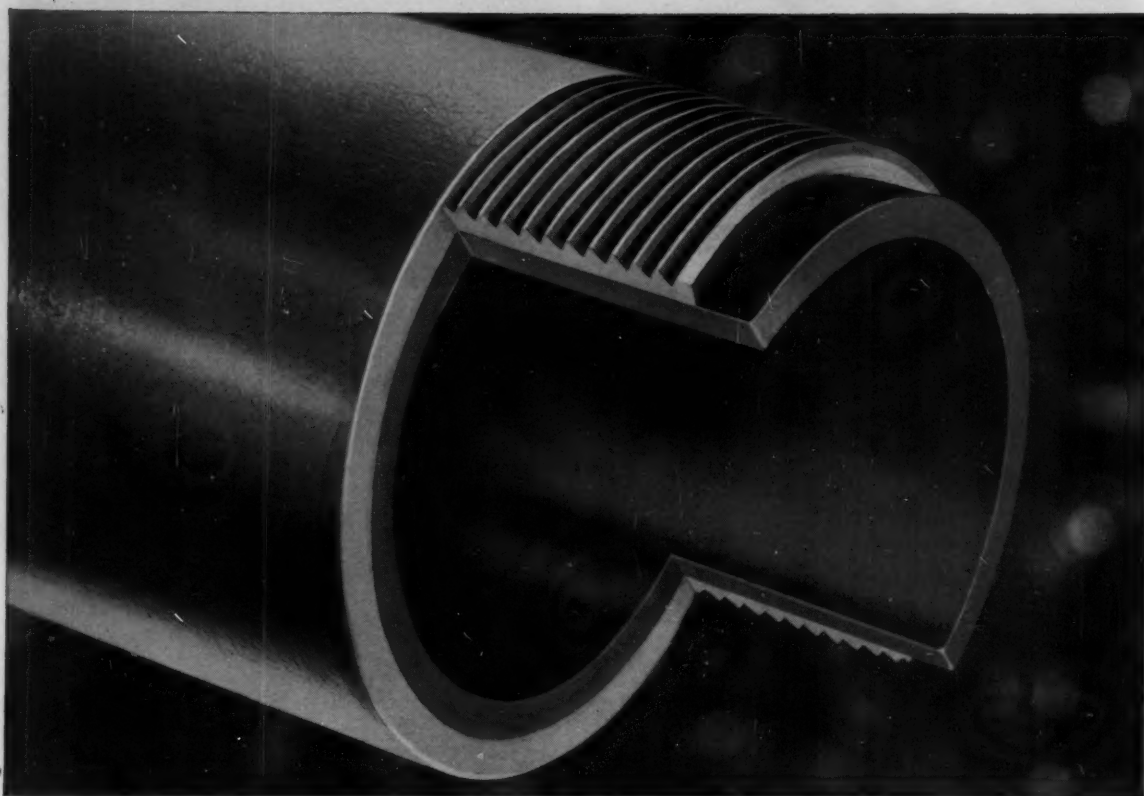
Through research  ... a better way

A.O. Smith
CORPORATION

PROCESS EQUIPMENT DIVISION
HEAT EXCHANGERS • PRESSURE VESSELS

Milwaukee 1, Wisconsin

International Division: Milwaukee 1, Wisconsin



Liquid never touches metal in saran lined pipe even at a flanged connection like this.

You can see why Saran Lined Pipe cuts corrosion costs

It's made of corrosion-resistant saran swaged into rigid non-bursting steel . . . liquid never touches metal in these installations

Here's your best way to convey acids, alkalis and other corrosive liquids—saran lined pipe, fittings, and valves. This modern piping is corrosion resistant . . . forms snug, leakproof joints . . . is available for working pressures up to 150 psi. Fittings and valves are also available in steel for working pressures to 300 psi.

Installation costs are low because saran lined pipe can be cut and threaded in the field with available pipe fitter's tools. Its rigidity means few supporting structures are needed.

Saran lined pipe has an outstanding record of trouble-free performance in many industries. THE DOW CHEMICAL COMPANY, Midland, Michigan.

Saran Lined Pipe Company
2415 Burdette Avenue
Farmdale 20, Michigan
Dept. SP626A

Please send me information on saran lined pipe, fittings and valves.

Name _____ Title _____

Company _____

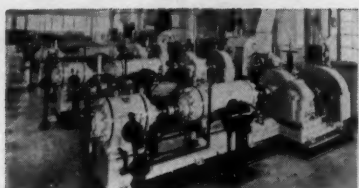
Address _____

City _____ State _____

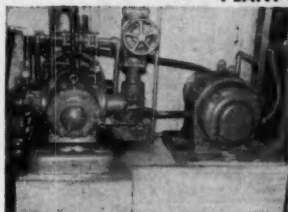
*Saran Lined Pipe is Manufactured by
The Dow Chemical Company, Midland, Michigan.*

you can depend on DOW PLASTICS

DOW



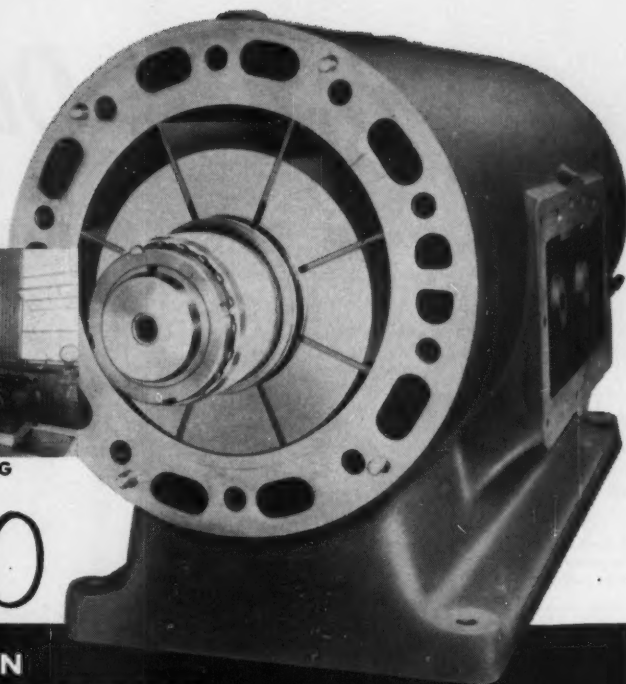
PLANT SERVICES



REFRIGERATION



GAS GATHERING



Since 1930

... FULLER ROTARY MOTION
has been the key to SMOOTHER, MORE EFFICIENT,
LOWER COST AIR COMPRESSION

The unique revolving principle pioneered by Fuller is the heart of the Fuller Rotary Compressor—both single- and two-stage types—and provides impressive cost, maintenance and operating advantages.

Simplified Fuller design consists essentially of a rotor eccentrically mounted in a cylinder to form a crescent divided into sections by the rotor blades. Each section or pocket carries air from one end of the crescent to the other without reversal of flow and with measurable improvement in volumetric efficiency. The rotor blades move freely by centrifugal force alone and compensate automatically for wear. As a result, Fuller Rotaries can operate indefinitely without care and the occasional inspection check required can be made with fewer men and in far less time.



Clip, fill in and mail the coupon for detailed information about Fuller Rotary Compressors for plant services, refrigeration or gas gathering.



134 FULLER COMPANY
Bridge St., Catasauqua, Pa.

A SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORP.
Chicago • San Francisco • Los Angeles • Seattle • Kansas City • Birmingham

Fuller

pioneers in harnessing AIR

C-288
3008

COST-SAVING ADVANTAGES

1. Smooth, pulse-free, one-way air flow
2. Almost complete lack of vibration permits use of light foundation
3. Far fewer moving parts insure low maintenance
4. Small size for high capacity permits installation in minimum space
5. Direct drive further reduces space requirements
6. Valveless design permits continuous, unsupervised operation and greatly reduces maintenance

Fuller Rotary Compressors:

- Maintain original capacity for the life of the machine
- Provide a high degree of reliability, thereby reducing standby capacity requirements
- Have few moving parts, thus sharply reducing parts inventory
- Require minimum supervision and inspection

It will pay you to compare Fuller Rotaries with other compressors and evaluate Fuller advantages to your operation in terms of annual net savings. Fuller Rotaries are available for industrial pressures to 125 psig and capacities to 3300 cfm. We will be glad to supply you with facts based on actual experience with Fuller installations over the past 25 years.

FULLER COMPANY

134 Bridge St., Catasauqua, Pa.

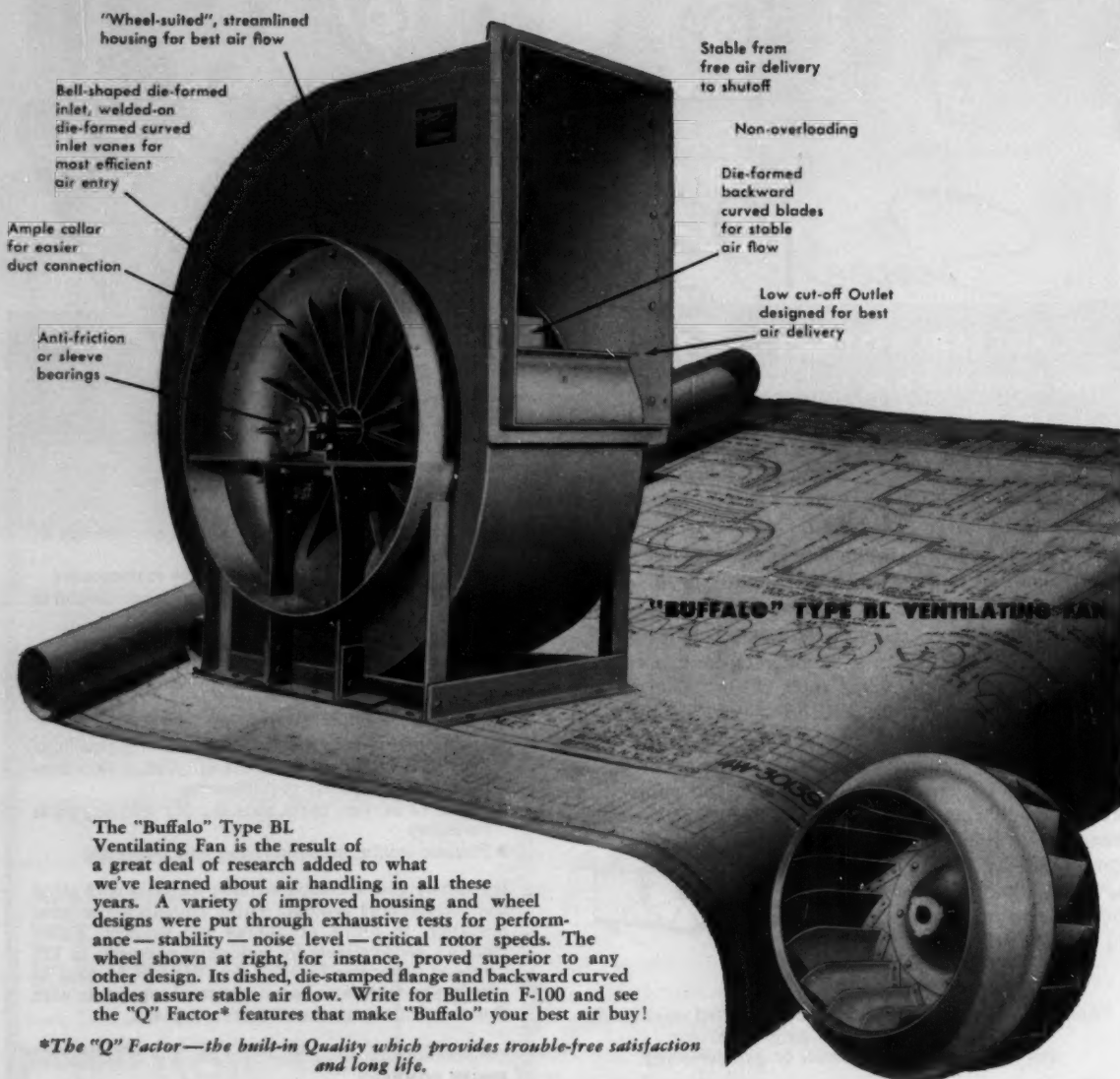
Please send me, without obligation, descriptive literature on the Fuller Rotary Compressor. I am specifically interested in a pressure of _____ psig and a capacity of _____ cfm, to be used for:

NAME _____ ☐ Plant Services
TITLE _____ ☐ Refrigeration
CO. NAME _____ ☐ Gas Gathering

STREET ADDRESS _____
CITY _____ ZONE _____ STATE _____

The Best of Our 79 Years

OF FAN ENGINEERING ARE IN IT!



The "Buffalo" Type BL Ventilating Fan is the result of a great deal of research added to what we've learned about air handling in all these years. A variety of improved housing and wheel designs were put through exhaustive tests for performance—stability—noise level—critical rotor speeds. The wheel shown at right, for instance, proved superior to any other design. Its dished, die-stamped flange and backward curved blades assure stable air flow. Write for Bulletin F-100 and see the "Q" Factor* features that make "Buffalo" your best air buy!

**The "Q" Factor—the built-in Quality which provides trouble-free satisfaction and long life.*



BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING



Changing basic designs to match the specifications of different machines or models is a fast, easy routine at Cleveland Trencher Company, Cleveland, Ohio—thanks to Kodagraph Autopositive Paper.

8 modifications of the original design *without a minute wasted on redrafting*

In the case of the transmission design drawings shown above, eight separate modified designs were required. So a like number of Autopositive Paper intermediates were made *instead of redrafting time after time*.

To each of these intermediates—with dense black photographic lines on a translucent base—the draftsman only had to add the variables and correct dimensions.

The Cleveland Trencher Company finds other important uses for Autopositive Paper intermediates—uses them instead of valuable original drawings in direct-process print production and in the “changes pending” file to show proposed revisions.

Another drafting-room favorite is Kodagraph Autopositive Film, which speeds the production of parts books illustrations. Complicated paste-ups are reproduced in exceptionally fine detail on this translucent film, which is used to produce direct-process prints or offset plates.

No negative step

Kodagraph Autopositive Paper and Film produce *positive* intermediates directly in *ordinary roomlight*. Only standard print-making equipment and familiar photographic processing are required. *A fast, easy routine for you or your local blueprinter!*



New booklet is jam-packed with valuable tips on saving drafting time, protecting drawings, getting better prints.

Kodagraph Reproduction Materials

—MAIL COUPON FOR FREE BOOKLET—

EASTMAN KODAK COMPANY
Graphic Reproduction Division, Rochester 4, N. Y.

105

Gentlemen: Please send me a free copy of your new booklet on Kodagraph Reproduction Materials.

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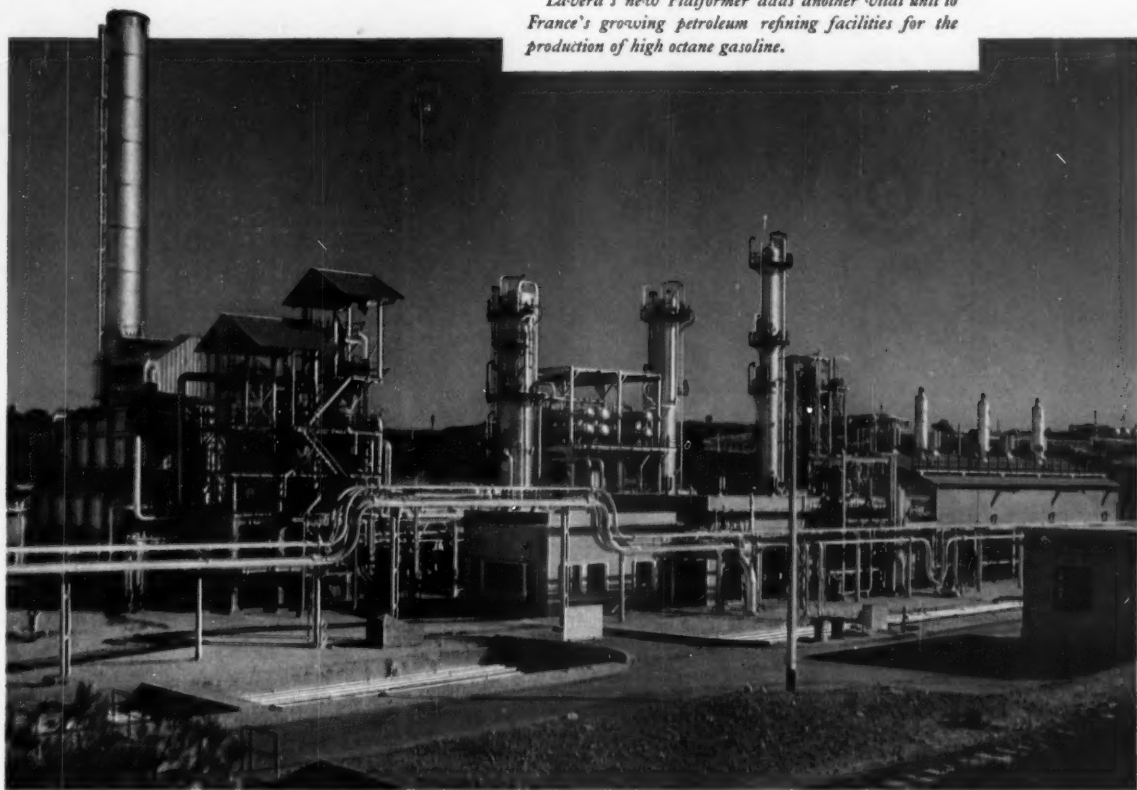
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Kodak
TRADE MARK

The Latest at LAVERA...

Lavera's new Platformer adds another vital unit to France's growing petroleum refining facilities for the production of high octane gasoline.



At the Lavera Refinery of Société Française des Pétroles BP, near Marseilles, France, a 6000 BPSD catalytic reforming unit has recently been completed.

In the design and construction of this modern processing unit the engineering knowledge and methods of three great nationalities were coordinated and combined for the progress and expansion of free world enterprise. The unit embodies the latest United States design techniques, adapted to French standards by English and French engineers. It incorporates materials and equipment largely of French manufacture and was constructed by French mechanics.

Stone & Webster Engineering Corporation, in cooperation with its British and French affiliates, provided the necessary engineering, procurement and supervisory construction services.

This and the similar units erected at Kent Oil Refinery Ltd. and National Oil Refineries Ltd. for The British Petroleum Company Ltd., in the United Kingdom illustrate the international scope of integrated assistance available to refiners throughout the free countries of the world by the Engineering Corporation and its affiliates.



Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION BADGER PROCESS DIVISION

AFFILIATED WITH E. B. BADGER & SONS LIMITED (LONDON)

New York Boston Chicago Pittsburgh Houston San Francisco Los Angeles Seattle Toronto

R-5051
Twin
Cartridge
Respirator


Respiratory
Protection



Two **AO**[†] Best Buys in Respirators for Paint Spraying!

- Exceptionally Long Filter Life
- Extremely High Efficiency

R-2031
Respirator

For complete security and the finest respiratory protection against paint sprays and vapors you need only the AO R-5051 Respirator *plus* AO R-65 auxiliary filters which prevent droplets of paint from plugging the chemical cartridges. R-65 filters are packaged 200 per box and two R-66 auxiliary filter clamps are provided with each box of auxiliary filters. The R-5051 is approved by the U. S. Bureau of Mines for use against organic vapors. (Approval No. BM-2304.)

The single cartridge AO R-2031 Respirator is light in weight for comfort, highly efficient . . . and engineered for long life. For this quality protection in paint spraying merely order the R-2031 Respirator *plus* AO R-7 auxiliary filters. These auxiliary filters prevent paint droplets from plugging the chemical cartridge. R-7 filters are packaged 100 per box and are easily attached or removed from the respirator.

Your nearest AO Safety Products Representative can supply you with the face piece and components to meet your special needs. Check with him also for AO safety glasses and protective clothing.

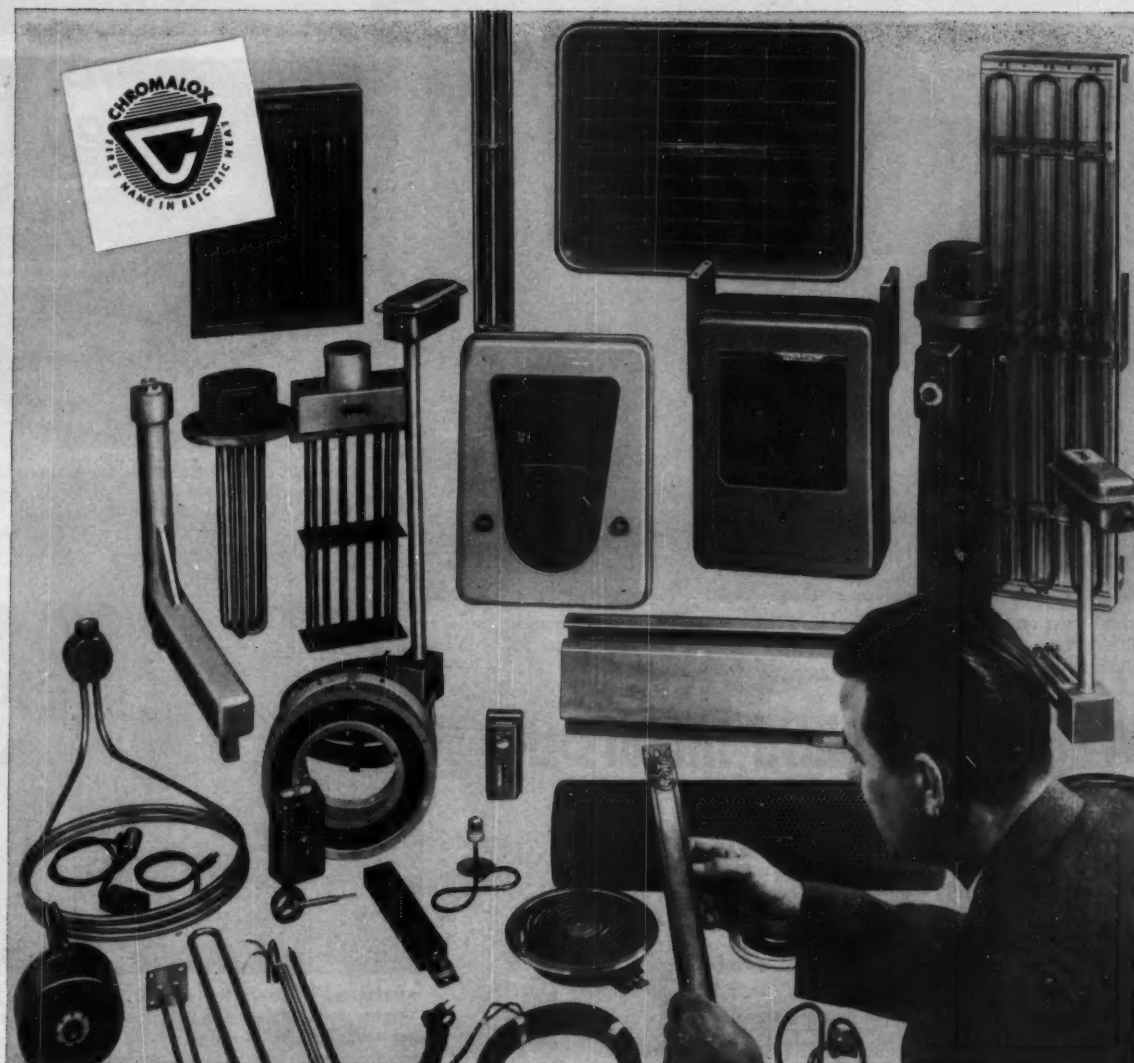
American Optical



SAFETY PRODUCTS DIVISION

[†]T.M. Reg. by American Optical Company

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Your Chromalox representative has the answer to your routine as well as unusual heating problems.

No matter where heat is needed, on the production line, in offices, warehouses, there is a Chromalox electric heating package especially designed for the job. Your Chromalox representative offers you prompt, competent counsel, on all heating problems.

His on-the-spot engineering assistance is backed up by thirty-nine years' experience and know-how in the design, manufacture and application of Chromalox electric heating units.

The Chromalox line, manufactured exclusively by Edwin L. Wiegand Company, is the world's most complete line of electric heating equipment. 15,000 standard types, sizes, and ratings... the world's largest stock... plus a complete range of controls and accessories.

Contact your Chromalox representative the next time you are faced with a

heating problem or write direct for application information.

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| <input type="checkbox"/> Process Air Heaters | <input type="checkbox"/> Strip Heaters | <input type="checkbox"/> Hi-Flow Portable Heaters |
| | <input type="checkbox"/> Comfort Heaters | <input type="checkbox"/> Utility Spot Heaters |

☐ Have a Field Engineer contact me.

Name _____ Title _____

Company _____

Address _____

City _____ State _____

8-704



WHERE DUST PREVAILS—A 60 hp, 1160 rpm Wagner motor drives this pulverizer which grinds down oversize fertilizer. Its totally-enclosed construction keeps fertilizer dust out and mechanical and electrical stability in.

Wagner Standard Motors do specialized jobs at Missouri fertilizer plant

The Missouri Farmers Association has its own fertilizer plant in Joplin, Missouri. Technically, it is called a "high analysis granulating unit." Principal chemical compounds manufactured are phosphoric acid and ammonium phosphates. With an annual capacity of 70,000 tons of fertilizer, this farmer-owned plant is one of two of its kind in North America.

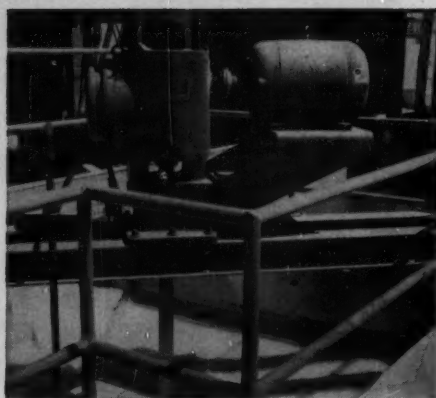
In this plant, designed by the Dorr Company and built by Merritt-Chapman and Scott Corporation, you'll find more than 100 standard Wagner totally-enclosed motors providing the power for pulverizers, grinders, blowers, conveyors and pumps, operating under adverse conditions—where open-type motors would quickly fail.

Whether it's a job of producing plant food or any of hundreds of other industrial operations . . . Wagner Standard Motors can do the job reliably, economically and well. Wagner engineers are qualified to specify the correct motors for your requirements. Consult the nearest of our 32 branch offices—or write for Bulletins MU-132 and MU-203.

Wagner Electric Corporation
6407 Plymouth Ave. • St. Louis 14, Mo., U.S.A.



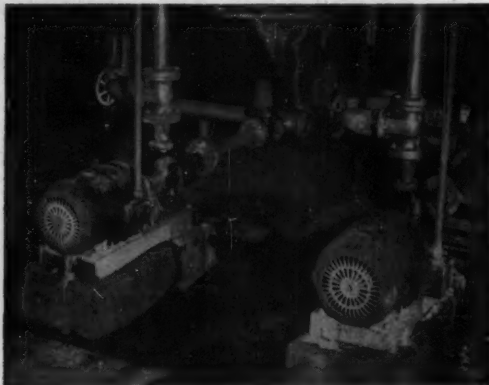
WH56-3



PERMITS OUTDOOR OPERATION—This Wagner 15 hp, totally-enclosed, fan-cooled motor drives an agitator which mixes hydrated lime with plant water. This motor's totally-enclosed, corrosion-resistant, cast-iron construction protects it from the elements and keeps it always "on the job."



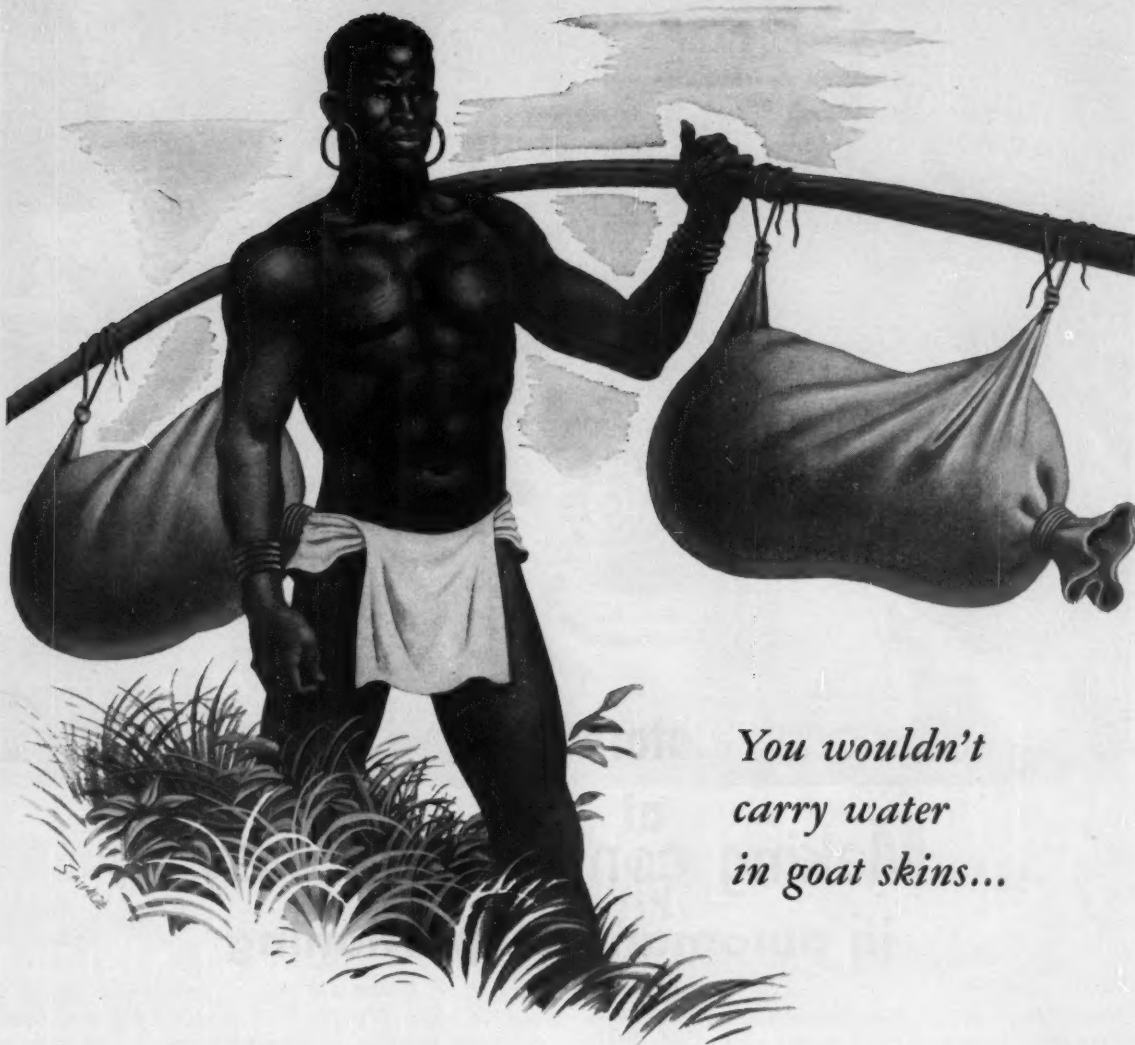
AT REDUCED SPEED—In this application, a 100 hp, 1160 rpm Wagner motor drives a Rotary Fertilizer Drier at 5 rpm through a Falk Motoreducer.



IN CORROSIVE ATMOSPHERE—These 5 hp, 3500 rpm Wagner motors drive pumps that handle 93% sulphuric acid. But even sulphuric acid is no deterrent to the reliable operation of these motors because of their corrosion-resistant cast-iron frames and totally-enclosed construction.

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ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS - AIR AND HYDRAULIC



*You wouldn't
carry water
in goat skins...*

...so why ship liquids the old fashioned way?

SWITCH TO SHIPPERS' CAR LINE FOR MODERN TANK CAR SERVICE



Shippers' Car Line is the exclusive sales agent and lessor of the ACF-built DURADOME tank car. When you buy or lease from Shippers' you get the finest tank cars available today. What's more... SHPX tank cars comprise the most modern fleet in operation... backed by ACF engineering

and a nationwide network of car repair shops to assure modern, efficient maintenance. Contact your Shippers' representative for all the details of modern tank car service—developed through more than 35 years experience in the leasing, operation and maintenance of tank cars for industry.

SHIPPERS' CAR LINE CORPORATION

A subsidiary of ACF INDUSTRIES, Incorporated
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CHICAGO, ILL. • HOUSTON, TEX. • SAN FRANCISCO, CAL. • MILTON, PA. • EAST ST. LOUIS, ILL. • SHACKOVER, ARK. • TULSA, OKLA. • NORTH KANSAS CITY, MO. • RED HOUSE, W. VA.

CHEMICAL ENGINEERING—April 1956



Making control look easy in automatic proportioning

These Richardson Scale Company technicians have an important job . . . checking out a remote control panel for a Richardson Select-O-Weigh Proportioning System. Large units or small, like this one—all get the same thorough pre-shipment test. Here accurate proportioning is made to look easy—just a matter of setting a dial. But there's *more* to automatic control than a control panel . . . much more!

Richardson engineers know that accurate control of material flow and exact proportioning *depend as much on precise design of storage bin, feeder, and scale* as they do on electronic perfection. The storage bin must be properly sloped to prevent bridging or flushing; the feeder must provide

positive, consistent material movement; the scale must weigh accurately to within superfine tolerances. And all must be integrated to insure a dependable, correlated performance—without human supervision all along the way!

The value to you of a Richardson Select-O-Weigh system lies in the quality of your finished product . . . both now and for year after profitable year. Protection of that quality is worth greater consideration than initial cost (and Richardson costs less on a value per dollar basis). It is worth your thorough analysis of the proportioning system itself! Richardson invites you to analyze—and specify—Select-O-Weigh. Send for Bulletin 0351 for more information.

When it comes to proportioning, you're in good company when you come to Richardson. Look at some of the others who now have proportioning by Richardson:

The Firestone Tire & Rubber Company • General Foods Corp.
General Electric Company • U. S. Bureau of Mines
Reynolds Metals Company • American Rice Milling Co., Inc.
Union Carbide & Carbon Corporation • Ford Motor Co.
Fleischmann Distilling Corp. • The Flintkote Company
Johnson & Johnson • National Distillers Products Corp.
Owens-Illinois Glass Co. • Pittsburgh Coke & Chemical Co.
Celanese Corp. of America • Goodyear Tire & Rubber Co.
E. I. Du Pont de Nemours & Co., Inc. • and many more.

Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

RICHARDSON SCALE COMPANY
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1906

"Squeeze-it" auto horn . . .
engineered to give 1906 pedestrians a sporting chance. It was
in 1906 that Brunner engineers
produced the first Brunner Air
Compressor.



TODAY

Brunner experience
provides engineered
"air power" for the
complete range of
compressed air needs!

BRUNNER MANUFACTURING COMPANY, UTICA, N. Y.
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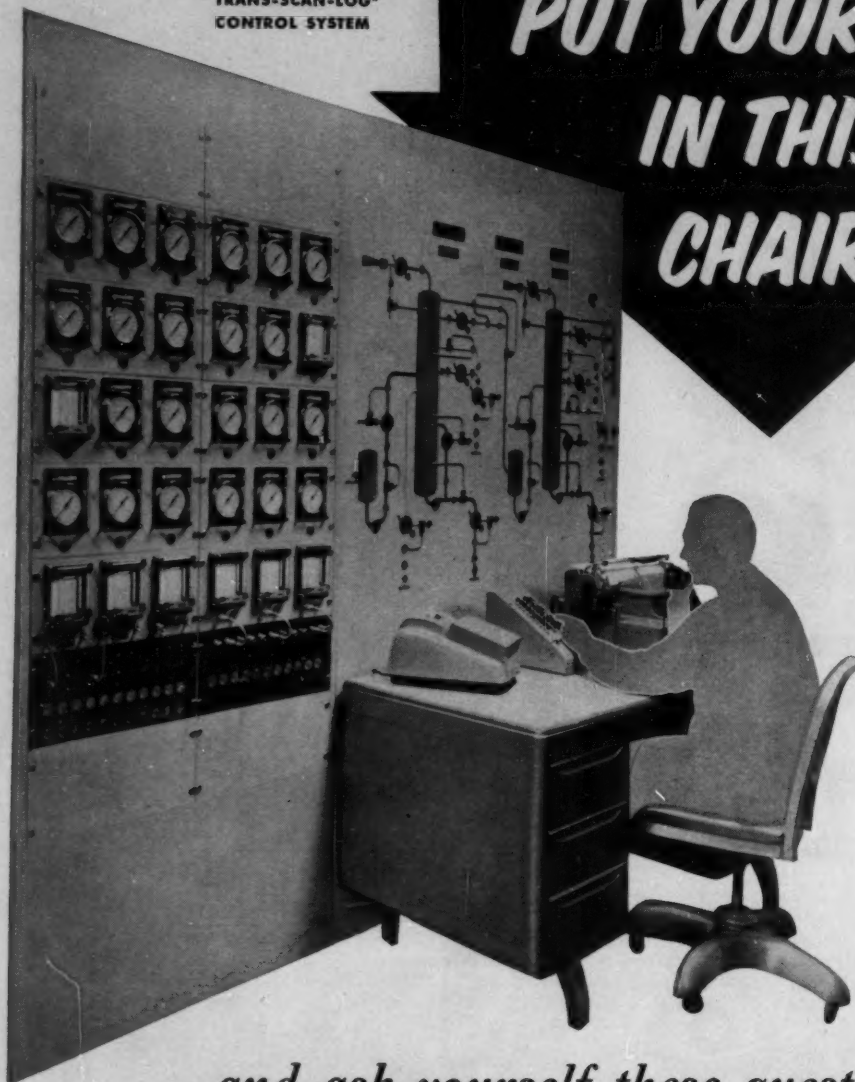
"GO BRUNNER"

For Air Compressors to fit any space, any
requirement. Choose from a complete line
of vertical, horizontal and "Du-Al" models
. . . from 1/4 through 50 H.P.



TAYLOR
TRANS-SCAN-LOG®
CONTROL SYSTEM

PUT YOURSELF
IN THIS
CHAIR



... and ask yourself these questions

Is scanning and logging, as I understand it, economically justified?

Perhaps not, if you're thinking just of mechanical logging of all variables, which gives little more than an accurate historical record of what has happened. But the new Taylor TRANS-SCAN-LOG System makes the operator more than a score-keeper. It enables him to instantly *visualize, evaluate and act upon* every processing irregularity as it occurs — without leaving his desk in front of the panel.

What effect would the TRANS-SCAN-LOG System have on my control room space and operator requirements?

It will take approximately 60% of the space normally required by a standard graphic panel *without* scanning and logging. The compactness of this "intelligence center" enables operator to supervise a greater percentage of the process. Because the scanning and logging equipment is an integral part of the process control, one operator can identify and correct any off-normal condition, as well as having a continuous trend record.

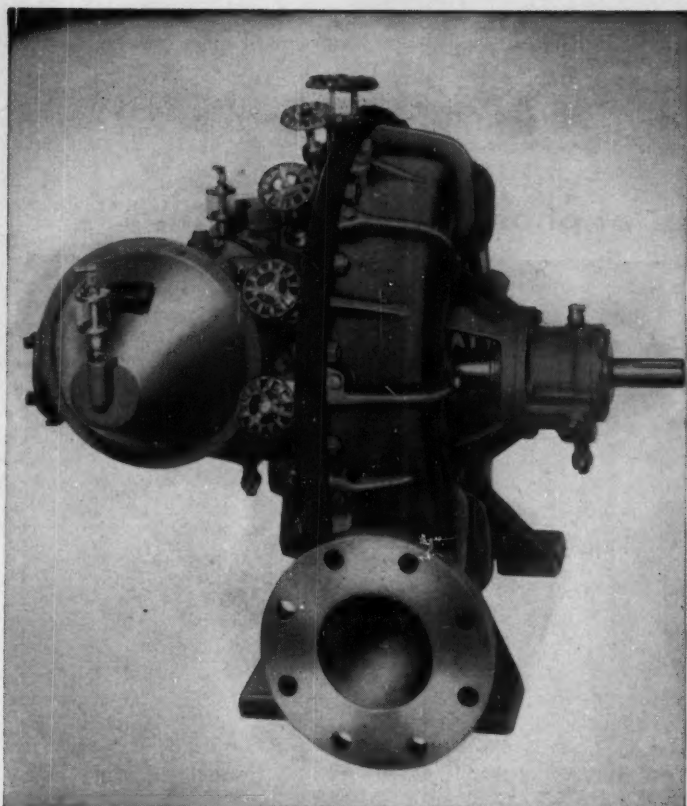
Where can I see this unit in operation?

We cordially invite you to come to Rochester to see this complete data collecting system in operation, because we believe that its many unique features *do* make it economically justified.

Your Taylor Field Engineer will be glad to make the necessary arrangements. In the meantime, write for **Bulletin 98268**. Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

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Taylor Instruments
MEAN ACCURACY FIRST



This is the reliable Coppus Turbine furnished with either type of wheel



Wide bucket "L" type wheel



Regular type wheel

Top performance in all **COPPUS TURBINES**

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that

a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed

safety trip supplementing constant speed governor.

- Replaceable cartridge type bearing housings.

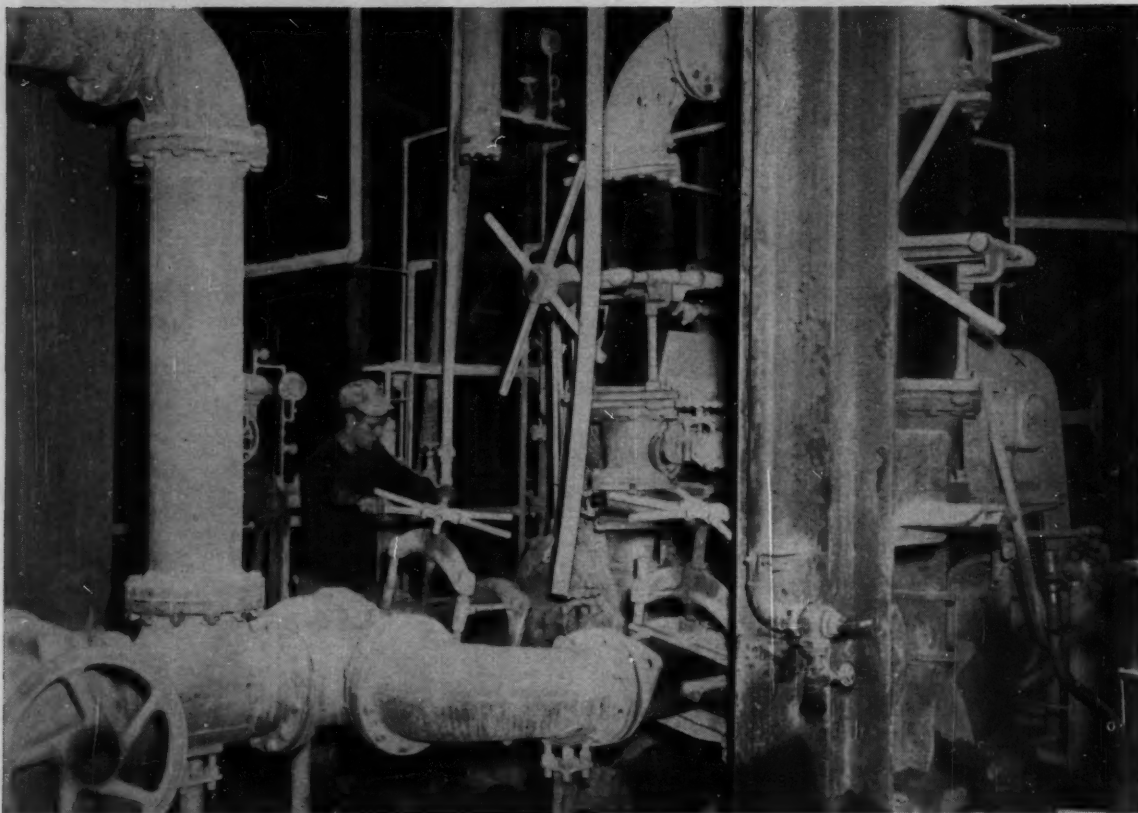
- Optional carbon ring packing glands.
- Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbines.

COPPUS ENGINEERING CORPORATION
224 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

COPPUS "BLUE RIBBON" **TURBINES**

"U. S. Pilot Pinch Valves Last Twice As Long..."

says production official of phosphate chemical plant



"And these U. S. Pilot® Pinch Valves," he adds, "don't clog or freeze — they are made of rubber. They don't require the babying of metal valves—and they play a major part on our production." Although the life expectancy of these "U. S." valves is twice that of metal valves they cost less to install.

This phosphate plant, located in Florida, manufactures animal food supplements and fertilizer. It is in operation 24 hours a day, 7 days a week. In this rugged round-the-clock routine, "U. S." products have proved economical and highly satisfactory. To control, pipe and connect the highly

corrosive and erosive semi-solids handled in the plant, U. S. Giant® Acid Hose, U. S. Expansion Joints and U. S. Pilot Flexible Pipe are used. The plant's officials have found that U. S. Rubber products are unmatched in facilitating production and in reducing maintenance and equipment charges. They have standardized on "U. S." products. It will pay you to take any and all corrosion problems to a "U. S." specialist.

Get in touch with any of our 27 District Sales Offices, or write United States Rubber Company, Mechanical Goods Division, Rockefeller Center, New York 20, N. Y.



Mechanical Goods Division

United States Rubber



Our Technical Service Laboratory Will Help You Build Better Products With Neville Resins

Neville Coumarone-Indene Resins have long been firmly established in the formulae for a wide range of products in the mastic floor tile, rubber, and paint industries and many others. They assist in the manufacture of better-looking, longer-wearing merchandise. Throughout the years, Neville has developed many variations of these versatile resins and has conducted constant research to adapt them to new employment. If your products are conceivably applicable, why not call upon our Technical Service Laboratory to assist your chemists in investigating their profitable

use. Use the coupon below to write for further information.

Neville Chemical Company • Pittsburgh 25, Pa.

Resins—Coumarone-Indene, Heat Reactive, Phenol Modified Coumarone-Indene, Petroleum, Alkylated Phenol • **Oils**—Shingle Stain, Neutral, Plasticizing, Rubber Reclaiming • **Solvents**—2-50 W Hi-Flash, Wire Enamel Thinners.

NEVILLE

Please send further information on Neville Chemicals.

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Photo courtesy Standard Oil Co., (N.J.)

stay on stream longer with the **LJUNGSTROM® AIR PREHEATER**

Slag—primary cause of reduced capacity—can be substantially reduced by the Ljungstrom Air Preheater...to keep you on stream at *top capacity* months longer.

That's because preheated air mixes more thoroughly with fuel. The result is better combustion...and less slag-forming material present in the furnace. Oil tubes stay cleaner...stills stay on stream at top capacity for months longer. As an example, one pipe still in an eastern refinery dropped from 16,000 barrels a day to 12,000 because of slag. Now, with a Ljungstrom and modern high-temperature burners, the still operates continuously at 18,000/20,00 barrels.

How fast is "WRITE OFF"?

By cutting turnaround time alone, the Ljungstrom means major savings for you. When you take the other Ljungstrom advantages into account—up to 20% fuel saving...more

economical furnace design, with no need for convection surfaces...burns many fuels you used to throw away...consistently higher through-put...higher product quality—you can see why a Ljungstrom is paid out in just a few months.

For more complete details on what the Ljungstrom Air Preheater can do for you...for an analysis of the heat recovery benefits attainable in fuel burning equipment—call or write The Air Preheater Corporation.

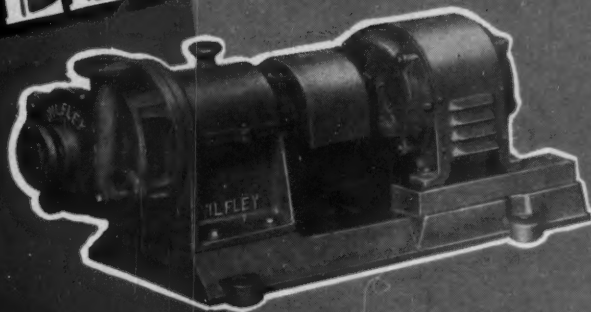
Wherever You Burn Fuel, You Need Ljungstrom

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.



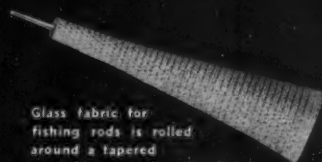
The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

From **WILFLEY** ACID PUMPS



... to GLASS FABRIC

Fishing rods are one of many glass products that originate in chemical plants where the basic ingredients are handled by Wilfley Acid Pumps. These highly efficient pumps operate without attention, delivering trouble-free performance on 'round-the-clock schedules. Let Wilfley reduce your pumping costs and increase production. Available with pumping parts of the machinable alloys as well as plastic to meet all requirements. Individual engineering on every application. Write, wire or phone for complete details.



Glass fabric for fishing rods is rolled around a tapered steel form and heat-bonded. The form is then removed, creating the tubular glass rod blank.



... to FISHING RODS

A. R. WILFLEY and SONS, INC.

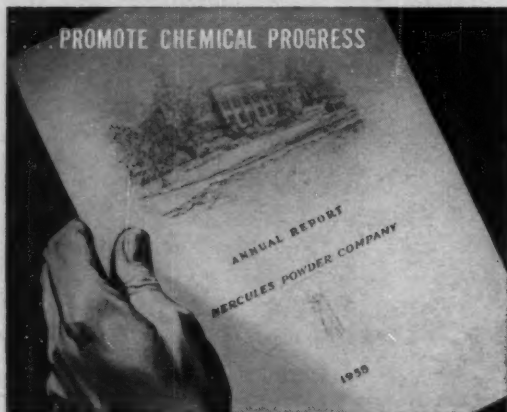
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HOW *HERCULES* HELPS...



THE NEW CONTINENTAL, Ford Motor Company's super-luxury car, is a quality product from bumper to bumper. Naturally, the finish is the finest available—lacquer based on Hercules® nitrocellulose. Quick drying and long wearing, versatile lacquer is the standard of quality wherever the finest in finishes is sought. (Lacquer for the Continental manufactured by Rinshed-Mason Co., Detroit, Mich.)



HERCULES' CONTINUING EXPANSION is reflected in an increase in sales from \$7,640,741 in 1913 to \$226,651,058 in 1955, 11,259 employees, and an unbroken history of consecutive dividends since Hercules' organization in 1913. Send for your copy of our annual report.



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**SYNTHETIC RESINS, CELLULOSE PRODUCTS, CHEMICAL COTTON, TERPENE CHEMICALS,
ROSIN AND ROSIN DERIVATIVES, CHLORINATED PRODUCTS, OXYCHEMICALS,
EXPLOSIVES, AND OTHER CHEMICAL PROCESSING MATERIALS.**

HERCULES

CHEMICAL MATERIALS FOR INDUSTRY

April 1956—CHEMICAL ENGINEERING

If your
processing
involves:

GRATES or SUSPENDING BEDS
PROTECTIVE ATMOSPHERES
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MALEIC ANHYDRIDE SYNTHETIC GAS GENERATION
NITRIC ACID MANUFACTURE CATALYTIC REFORMING
ETHYLENE OXIDE PHTHALIC ANHYDRIDE
DEHYDRATION DEHYDROGENATION

You can benefit by using ALUNDUM* catalyst carriers

More and more chemical engineers are finding in Norton ALUNDUM catalyst carriers the R's they need for faster, better, lower cost production in a wide range of processing.

These fused alumina carriers are characterized by excellent mechanical, thermal and chemical stability. They have high resistance to abrasion and erosion,

and their low density is useful for packing and filling applications. Catalytically, they are crystalline in nature and are produced in two surface area types: low and intermediate. Intermediate surface area carriers are subdivided into types A, B, and C, with varying characteristics.

TYPICAL CHEMICAL ANALYSES (%'s)			PHYSICAL PROPERTIES						
	LOW SURFACE AREA	INTERMEDIATE SURFACE AREA		Porosity	Water Absorption	Bulk Density	Vol. Bulk Density	Crystal Structure	Surface Area
Al ₂ O ₃	89.4-76.6	77.0	Low Surface Area	40-50%	20-25%	1.90-2.10 gr/cc	65-80 lbs/ft ³	Alpha Alumina	Less than 1m ² /gram
SiO ₂	9.3-16.8	21.2	Intermediate Surface Area Type A	50-55%	28-30%	1.65-1.70 gr/cc	58 lbs/ft ³ (app)	Alpha, Gamma Alumina- chiefly Gamma	60-70m ² /gram
Fe ₂ O ₃	0.5 - 1.3	0.2	Type B	50-55%	28-30%	1.65-1.70 gr/cc	60 lbs/ft ³ (app)	Quartz, Alpha, Kappa, Delta Alumina- chiefly Quartz	20-30m ² /gram
MgO	0.1 - 0.6	0.4							
CaO	0.1 - 0.8	0.5							
Na ₂ O	0.3 - 0.4	0.2	Type C	50-55%	28-30%	1.65-1.70 gr/cc	62 lbs/ft ³ (app)	Alpha Alumina and Mullite	5-10m ² /gram
K ₂ O	0.1 - 1.0	0.5							
TiO ₂	0.2 - 2.5	0.5							

Shapes and Sizes

Spheres: (Low surface area) $\frac{3}{16}$ "-1" diam; (Intermediate surface area) $\frac{1}{4}$ "- $\frac{1}{2}$ " diam. Pellets: (All carriers) $\frac{1}{8}$ " x $\frac{1}{8}$ "- $\frac{1}{2}$ " x $\frac{1}{2}$ ". Rings: (All carriers) $\frac{1}{8}$ " x $\frac{1}{4}$ " x $\frac{3}{8}$ " O.D.-1" x $1\frac{1}{2}$ " x $1\frac{1}{2}$ " O.D.

Typical Applications

Low Surface Area Carriers: phthalic anhydride, maleic anhydride, ethylene oxide, protective atmospheres, synthetic gas generation, grates or suspending beds for active catalysts.

Intermediate Surface Area Carriers:

catalytic reforming, dehydrogenation, dehydration, sulfuric acid manufacture, nitric acid manufacture, dessicants.

Get More Facts

on how Norton ALUNDUM catalyst carriers are engineered and prescribed to give you the most effective combination of physical, thermal, chemical and electrical properties. Learn how they can improve and economize your processing. Call in your Norton Refractories Engineer, or write, mentioning your specific requirements, to NORTON COMPANY, 503 New Bond St., Worcester

6, Mass. Canadian Representative: A. P. Green Fire Brick Co., Ltd., Toronto, Canada.

NORTON

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Engineered... **R**... Prescribed

Making better products...

to make your products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

QUALITY and DEPENDABILITY Right Down The Line . . .



*Whatever Your Needs In Tubing . . .
You're 'Way Ahead With WELDCO*

**. . . Because WELDCO Pipe and Tubing Are Made
With The Exclusive Double-Fusion Welding Process**

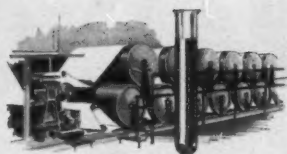
You get quality, uniformity, dependability in every length of WELDCO Tubing, because WELDCO is produced by specialists . . . men who have the experience, equipment, and facilities to make Pipe and Tubing to your exact specifications.

WELDCO is available in Stainless Steel, Monel, Inconel, Nickel, Cupro-Nickel, and Hastelloy, in Tube and Pipe sizes from 3" to 30", Schedules 5, 10, and 40. For special problems, or regular applications, always specify WELDCO and be sure of getting top-quality, dependable products!

THE YOUNGSTOWN WELDING & ENGINEERING CO., 3718 Oakwood Ave., Youngstown 9, O.

WELDCO

hello!



We create and make *specialty papers*, to take the place of other materials in a large and varied number of today's products, to make them *better*, for *less*.



These *specialty papers* are made from natural, synthetic, and glass fibers. They are strong, porous, pliable, absorbent, soft, practically limitless.



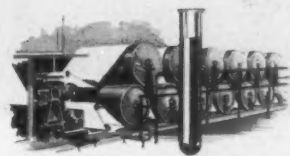
Perhaps you could use a Dexstar Specialty Paper, in place of other material, to make *your* products better, for less? There are so many applications —



Our papers, dry, are used for filters, electrolytic capacitors, vacuum cleaner bags, flat silver wrapping, lens tissues, high temperature electrical insulation.



We make "wet strength" papers for tea bags, liquid filters, cheese processing, chamois-like wipers, hair-wave kits, wallboard tape, duplicating stencils.



Yes, we can custom-make paper with most any degree of porosity, absorbency, wet, dry, lateral or longitudinal strength — or any combination of these factors.



Perhaps you could use a Dexstar Paper, formulated to your specifications, to make *your* products better, for less? We'd be happy to discuss it.



SPECIALTY PAPERS FOR INDUSTRY

This is our trade-mark. We've been in the *specialty paper* business over a hundred years, serving hundreds of people. And we're as near as your phone.

C. H. DEXTER & SONS, INC.
Windsor Locks, Connecticut

Gentlemen: Let's discuss problems.

Name _____

Address _____

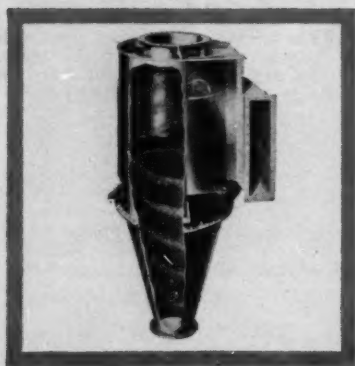
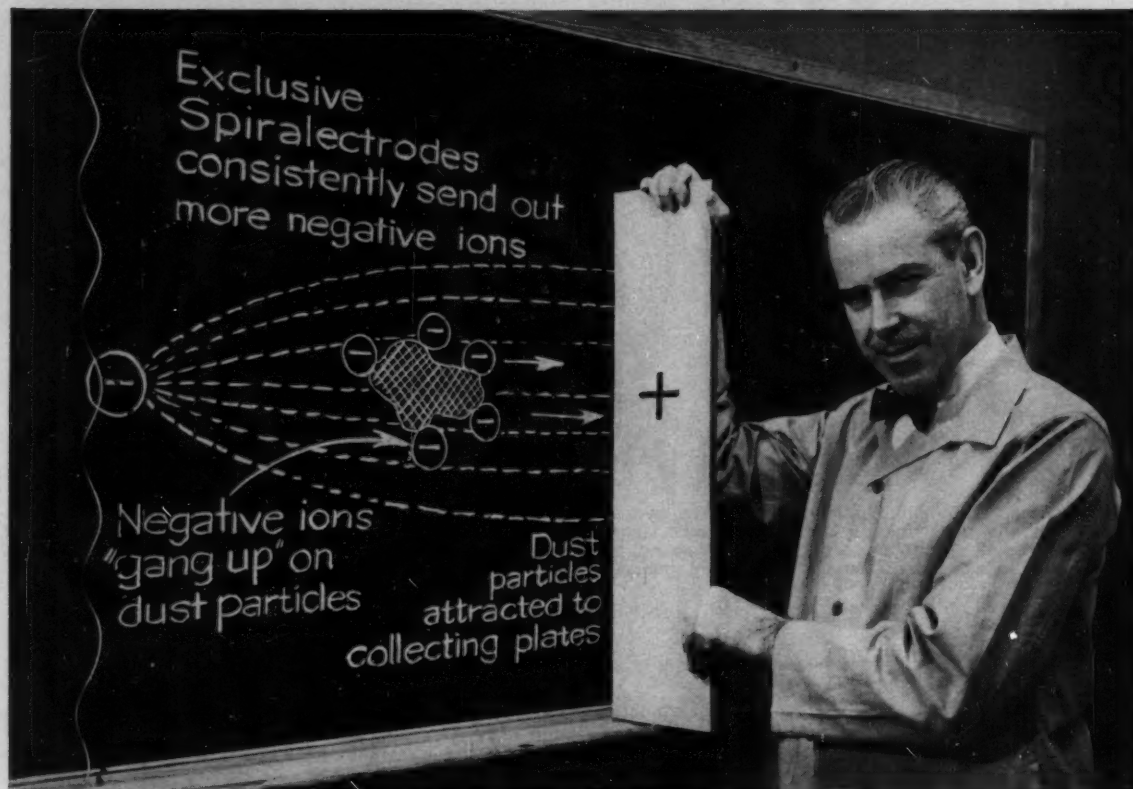
City _____ State _____

Why not let us study *your* situation? A simple inquiry can put our complete research and development laboratories, our modern machinery — at *your* service!

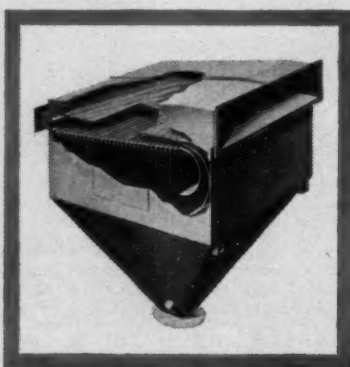
C. H. DEXTER & SONS, INC.

WINDSOR LOCKS 11, CONNECTICUT

How a Buell Collection System "gangs-up" on dust to meet the toughest air pollution codes



Buell Cyclones also deliver extra collection efficiency to "gang-up" on dust: Exclusive Shave-off design harnesses double-eddy current and puts it to work.



Buell's Low Resistance Fly Ash Collector combines high efficiency to meet present day strictness, with low draft loss for natural or mechanical draft installations.



FOR THE COMPLETE STORY

Write:

Buell Engineering Company
Dept. 12-D, 70 Pine Street
New York 5, New York

buell



Experts at delivering Extra Efficiency in **DUST COLLECTION SYSTEMS**

SPECIAL... for chlorine service

OIC 600-LB. FORGED STEEL, O. S. & Y. VALVES

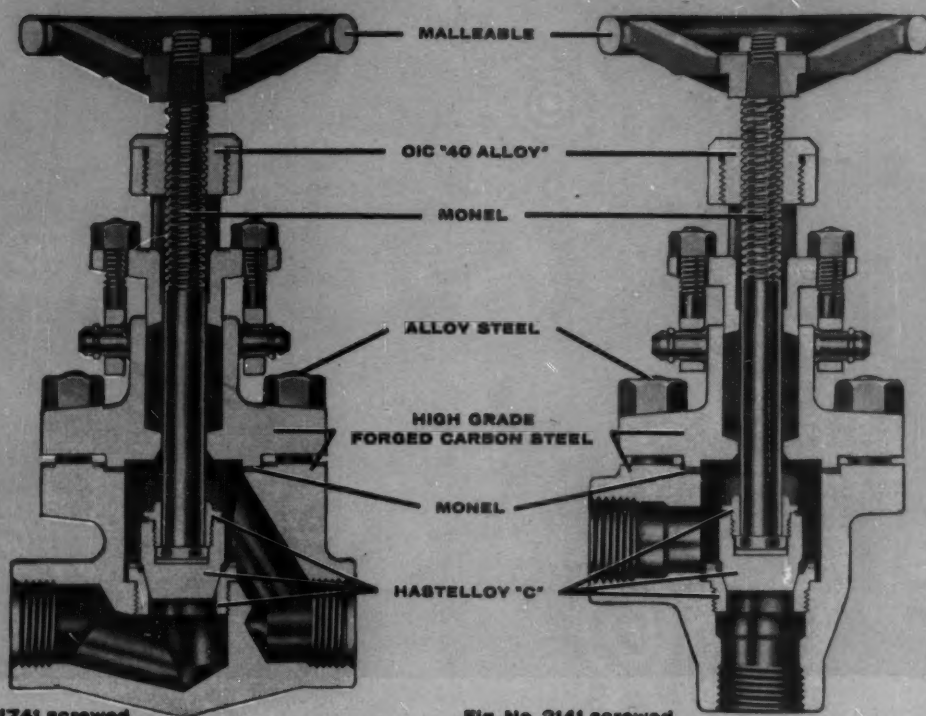


Fig. No. 1741 screwed
Fig. No. 1740 flanged

Fig. No. 2141 screwed
Fig. No. 2140 flanged

Proper design and the correct choice of metals combine in this OIC Forged Steel line to assure adequate strength, safety, and long trouble-free operation on chlorine service.

Hastelloy "C" swivel nut—disc—seat ring—Resist corrosive action of chlorine, increasing service life.

Monel stem—body—bonnet gasket—The monel stem resists corrosion. It is of generous size and accurately machined for ease of operation. The soft monel gasket is ideal for chlorine service.

OIC "40 Alloy" yoke bushing—"40 Alloy" is an aluminum-silicon-bronze which will not corrode, gall or seize. Its use adds to the ease of operation and increases the valve's service life.

High-Grade Forged Carbon Steel pressure parts—Ample proportioned wall thicknesses throughout provide strength and safety.

Alloy Steel Bolting 4 bonnet studs—Of proper

size and quality to assure safety and ruggedness at the joint.

Malleable handwheel—Heavy and large, shaped for non-slip gripping.

Packing is resistant to the corrosive action of chlorine. A back seating arrangement permits re-packing in a full open position.

A wide seating surface of 30° included angle permits close flow regulation. Each valve is carefully inspected at assembly, and tested at 300 psi air under water.

Write for Bulletin No. 1000, which describes these valves more fully. It also contains information on valves for black, green and white liquor services. Request also Bulletin No. 195, which describes the redesigned OIC line of Forged Steel Gate Valves.

Contact your nearby OIC Distributor for all your valve needs.



VALVES

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

FORGED & CAST STEEL, LUBRICATED PLUG,
BRONZE & IRON



against calcium hypochlorite attack

TITANIUM boosts service life over 1500%

These filter press parts demonstrate the remarkable service life titanium can bring to chemical processing equipment.

Both parts are shown after use in the same application—pressing solid cakes from slurries of calcium hypochlorite. *But there the similarity ends.* Badly pitted, the part on the left made from one of the best corrosion-resisting metals lasted two weeks. The gleaming REM-CRU titanium part on the right is still going strong after seven months—without a trace of pitting or other corrosion.

Replacement savings vs. cost

No wonder titanium is justified in so many applications! The extra service life made possible by its corrosion resistance alone often makes titanium the most economical selection. Furthermore, as titanium's downward price

trend continues, the "pay-out" time for titanium parts becomes progressively shorter.

Other titanium properties

While titanium's corrosion resistance is often its most important characteristic, don't overlook its other excellent properties. Titanium is unusually resistant to erosion by high-velocity fluids... is entirely free from stress-corrosion cracking... withstands abrasion, shock and fatigue... has a uniquely high strength-weight ratio that means substantial reduction in weight and cost of material needed for a given use.

When the going's tough for ordinary metals—try REM-CRU titanium. For specific recommendations, call or write REM-CRU today.

To keep abreast of the latest developments on this vital metal, write to Dept. C-4 for the Rem-Cru Review—a free periodical presenting the latest technical data on titanium alloys.

REM-CRU TITANIUM

REM-CRU TITANIUM, INC., MIDLAND, PENNSYLVANIA

WEDGEPLUG
NON-LUBRICATED
STEEL PLUG VALVES

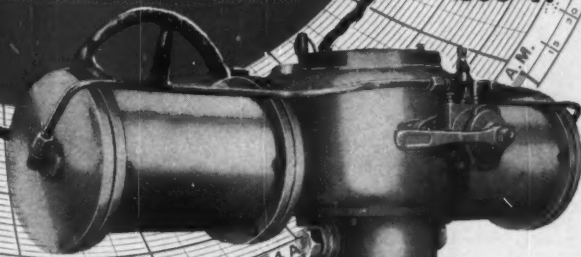
DEPENDABLE
at high
TEMPERATURE

CARBON STEEL

up to
1000° F.

SPECIAL METALS

up to
1500° F.



**CYLINDER-
OPERATED**

PROVEN PERFORMANCE

Wedgeplug Non-Lubricated Steel Valves have an enviable record of performance under high temperatures — handling extremely hot oils, hot catalysts, hot gases, hot slurry. The design eliminates need for lubrication . . . Adapted for remote control through use of electric, air motor or air cylinder operator.

Write for Wedgeplug Catalog No. 55-1-W

WEDGEPLUG VALVE COMPANY, INC.
NEW ORLEANS 25, LA.

An Affiliate of

STOCKHAM VALVES & FITTINGS
GENERAL OFFICES AND PLANT • BIRMINGHAM 2, ALA.



How we maintain **YOUR** quality control

Every USS Steel Drum goes through three careful steps to make certain your product arrives at your customer's door as pure as it left your plant.

All surfaces of the drum body, head, and bottom are completely descaled, then purged with a strong alkali solution, removing all traces of dirt and grease. With the interior and exterior now immaculately clean, the drum is ready for a thorough coating with a special phosphate formula that means long-term freedom from rust. Each of these

steps is vitally important to quality-controlled shipping. They mean that nothing will happen to your product during shipment or storage that could nullify the results of your own rigid quality control measures during manufacture.

USS Steel Drums are available in sizes from 2½ to 110 gallons, either plain or decorated. If yours is a special case . . . we have a wide variety of fittings and openings that are sure to meet your individual requirements.

"It's Better to Ship in Steel"

UNITED STATES STEEL PRODUCTS DIVISION

UNITED STATES STEEL CORPORATION

DEPT. 246, 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

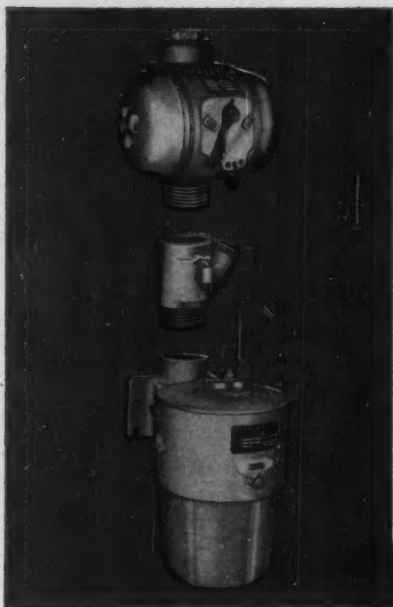
Los Angeles and Alameda, Calif. • Port Arthur, Texas
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SEE The United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

USS STEEL DRUMS



UNITED STATES STEEL



For complete protection...
against explosion, dust, rain... use

APPLETON

INDUSTRY'S MOST ADVANCED LINE

**Circuit Breaker, Motor Starter
and Combination Motor Starter
UNILETS®**

More TOP-QUALITY features!

- First to be U.L. Approved for banked circuit breaker grouping
- Combinations meet U.L. requirements through approval of components
- No shut-downs while entering motor starter of a combination
- Full 7-thread Explosion-Proof protection
- Unmatched accessibility
- Compact, lightweight construction
- Units may be added quickly, easily
- Flexible field set-ups with single and duplex male and female hub adapters

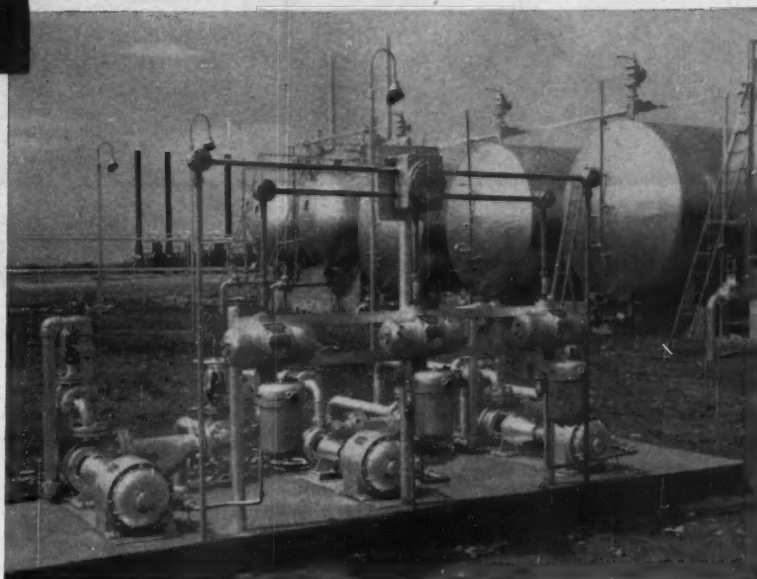


Photo courtesy Oil & Gas Journal

APPLETON Circuit Breaker and Motor Starter Unilets on tank car loading pump motors in field processing plant.

Also Manufacturers of:



Explosion-Proof Fixtures



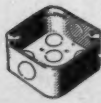
"ST" Series Connectors



Reels



Industrial Lights



Outlet Boxes



The biggest advancement in Explosion-Proof design in years!

The design, construction and performance of APPLETON Circuit Breaker and Motor Starter Unilets give you maximum safety and unparalleled ease of wiring, installation and maintenance. You'll discover initial and long term savings plus many exclusive APPLETON features, not found in any other enclosure.

Where absolute safety is required, regardless of the installation, APPLETON can serve you better! Send for Bulletin BH today for complete information!

Sold Exclusively Through Selected Wholesalers

APPLETON ELECTRIC COMPANY

1742 Wellington Avenue • Chicago 13, Illinois

Rely on APPLETON . . . the Standard for Better Wiring



Installing an individual tray. Note the downcomer pipes and the special assembly rig.

Whitlock Precise Construction Conforms Exactly to your Need . . .

We are particularly proud of two multi-section copper distillation columns we made to close tolerance for a manufacturer of fine chemicals and pharmaceuticals. One of these columns has three and the other seven flanged and bolted sections. The construction is unusual since the entire unit is of copper except for the steel backing flanges, and the tolerance is extremely close with the large $49\frac{1}{4}$ " inside diameter. To assure minimum vapor short circuiting, a snap-type seal ring construction at the individual trays is included. However, the fabrication is so precise that a nearly perfect metal-to-metal contact between shell and tray is obtained without this extra precaution.

In strict accordance with Whitlock Manufacturing Standards, all welding operations on the copper employ the inert gas-shielded arc technique. These columns are an excellent example of the Whitlock Precise Construction available to our customers.

If your problem is a knotty one involving precise construction, unusual materials, or special design, you will find our experience and facilities very helpful. Whatever your heat exchanger problem . . . complex or simple . . . ask us for recommendations. Our engineering, designing, manufacturing, and testing facilities are at your disposal.

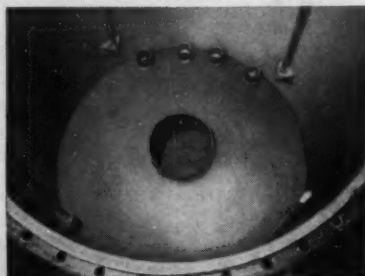
Whitlock

THE WHITLOCK
MANUFACTURING COMPANY
94 South Street
West Hartford 10, Conn.
In Canada:
Darling Brothers, Ltd., Montreal

Designers and builders of bends, coils, condensers, coolers, heat exchangers, heaters, piping, pressure vessels, receivers, reboilers.



One of the individual copper sections, showing the steel backing flanges and the perforated bubble caps and downcomers arranged about the tray. Each section contains five trays.



This special intermediate column section, before the installation of trays, shows the flanged, convex copper head with a vapor opening and a part of the downcomer assembly.

Precision Built from Performance-Proven Design

The basic design of Layne vertical turbine pumps has been tried and proved under all kinds of operating conditions, both good and bad, the world over.

The finished pumps are produced by skilled craftsmen, in one manufacturing plant, using highest standards—Layne standards.

Industries, municipalities and agriculturalists can rely on the fact that it is prudent and safe to rely on Layne.

For example, consider Layne pump bowls—the very heart of a pump.—

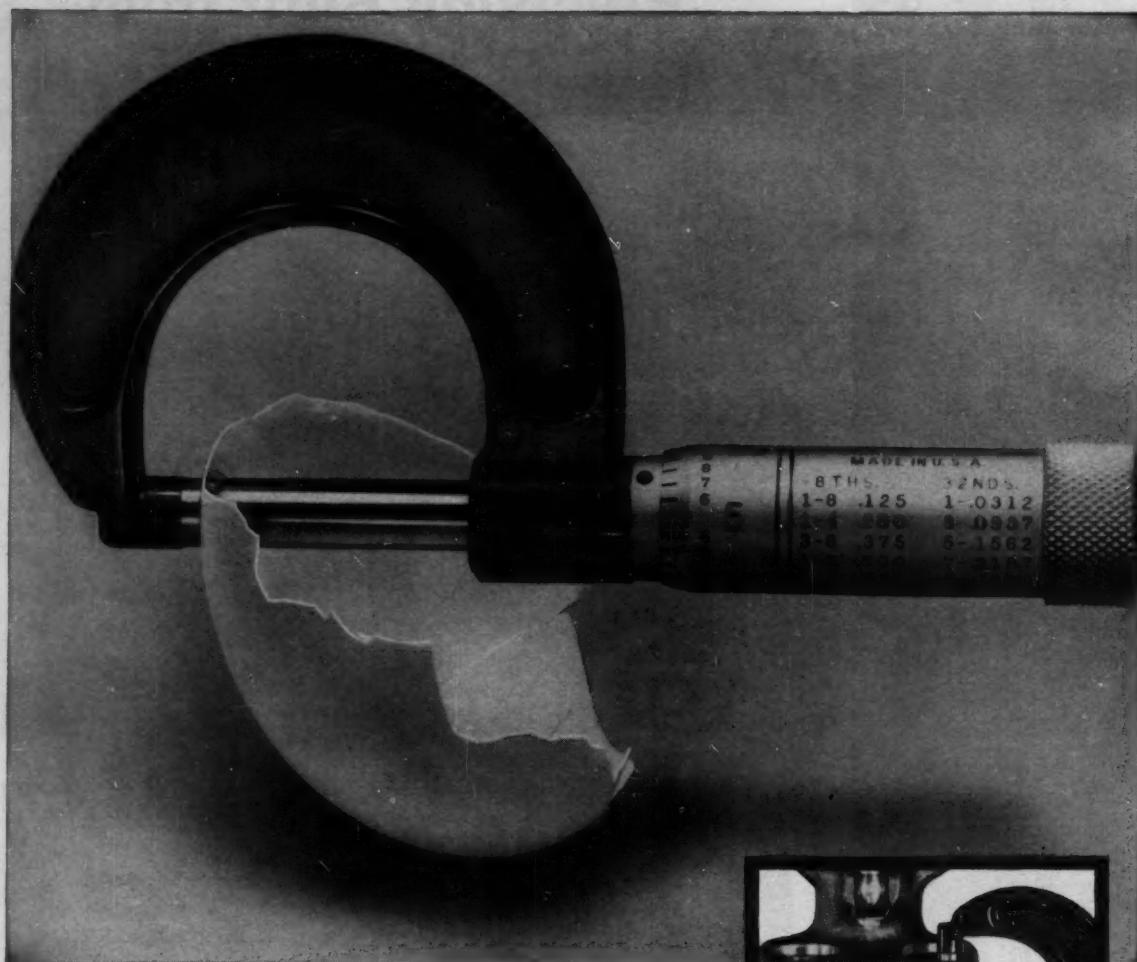
- ★ Designed by top flight hydraulic engineers, the best available anywhere.
- ★ Heavy, rugged construction to give long service under gruelling conditions.
- ★ Clean, smooth flowing water passages in intermediates and hand-finished impellers for high operating efficiencies throughout long operating life.
- ★ Careful and continuous production control from design board to shipping crate—nothing left to chance.
- ★ Produced with the prime objective of pumping water at minimum operating cost—**BETTER BUILT FOR BETTER SERVICE.**

LAYNE
& BOWLER, INC.
MEMPHIS
General Offices and Factory

LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD

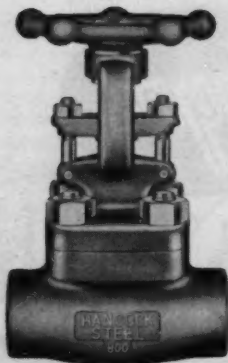
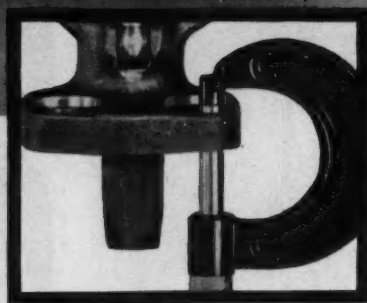


**Water Wells • Water Treatment
Vertical Turbine Pumps**



STRENGTH

that matches the purpose



THE BONNET FLANGES on the Type 950 Hancock Steel Gate Valve combine compactness with rugged strength *where strength is needed most*. Flange thickness and bolting provide sturdiness that can withstand more than ten times the rated pressure of the valve. Butting of the flange faces eliminates every possibility of bending and distortion.

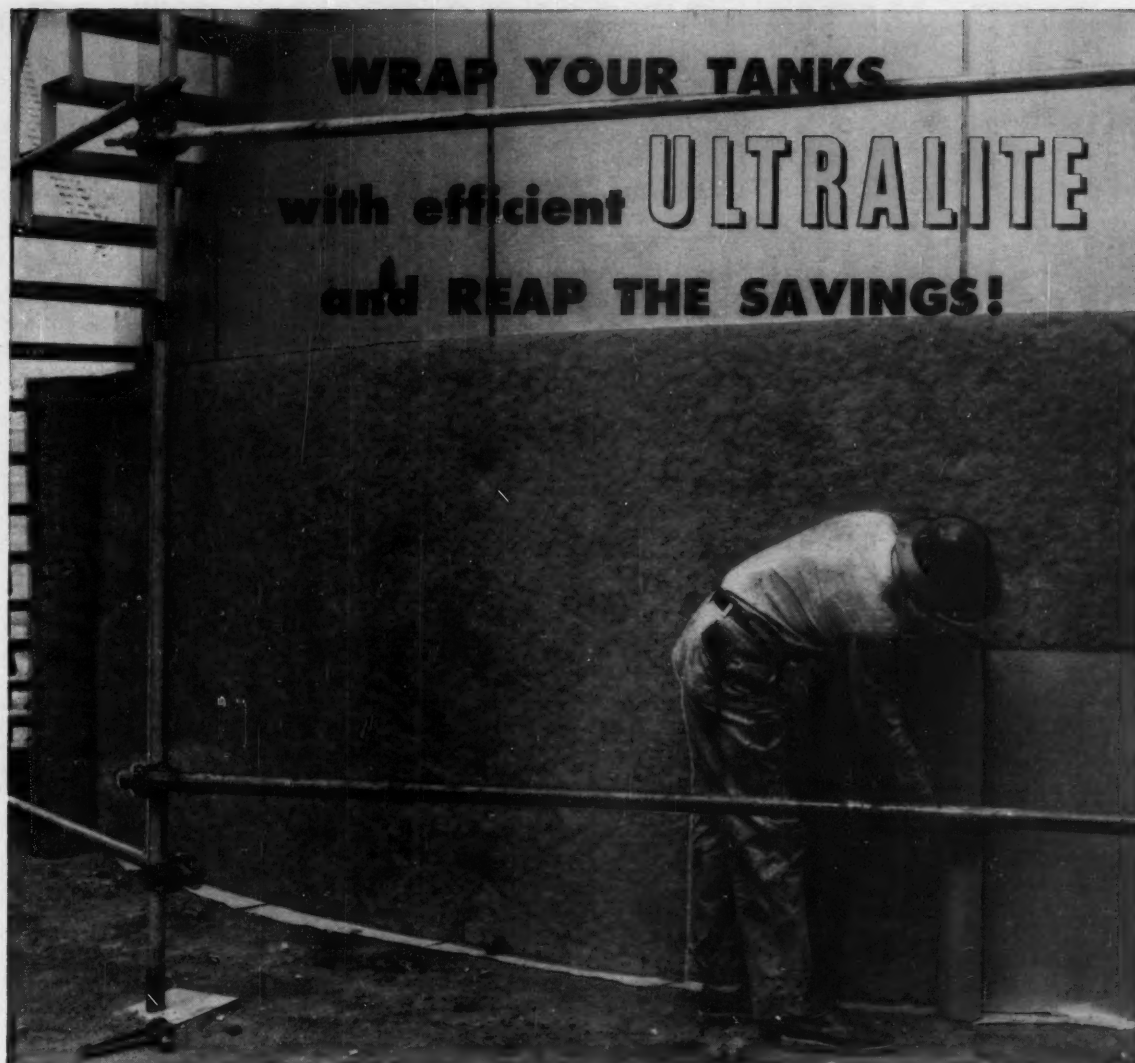
In revalving old, or installing new process and power piping systems, the enduring strength of Type 950 Hancock Steel Gate Valves always proves there is no substitute for the economy of quality. Get complete facts. Phone your Industrial Supply Distributor today.

HANCOCK VALVES

A product of
MANNING, MAXWELL & MOORE, INC.
 Watertown 72, Massachusetts

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario





WRAP YOUR TANKS
with efficient **ULTRALITE**
and **REAP THE SAVINGS!**

Quick as a flash, lightweight rolls of Ultralite glass fiber insulation can be run around tanks, vats and vessels — and that's more than *half* the battle in your war on insulating costs. The wider the roll, the quicker the job is done, and Ultralite is available in rolls up to 10 feet wide!

Consider the advantages of this New Way vs. the Old Way on a tank of about 4,000 sq. ft., like the one pictured. To do the job with Ultralite required just 4½ rolls, 150' long and in this case, 6' wide. One man can easily carry such a roll. One man can easily apply Ultralite. But, if you were to use individual insulation bats, 24" x 96", you'd need 250 bats . . .

and how many men would you say? And while you're figuring the saving, don't forget that you need twice as many welded mounting clips to apply bats as you do to apply Ultralite blankets.

Versatile and efficient Ultralite has other advantages, too, as insulation for all types of large heated equipment. It's resilient — not rigid — so that it can't crack under normal expansion and contraction. Its superior thermal efficiency means substantial heat savings over the years, and of course, Ultralite is as permanent as glass itself.

Next time, use Ultralite. It figures.

WRITE TODAY FOR "HOW-TO-DO-IT" DETAILS AND SPECIFICATIONS

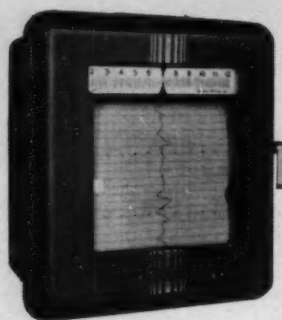
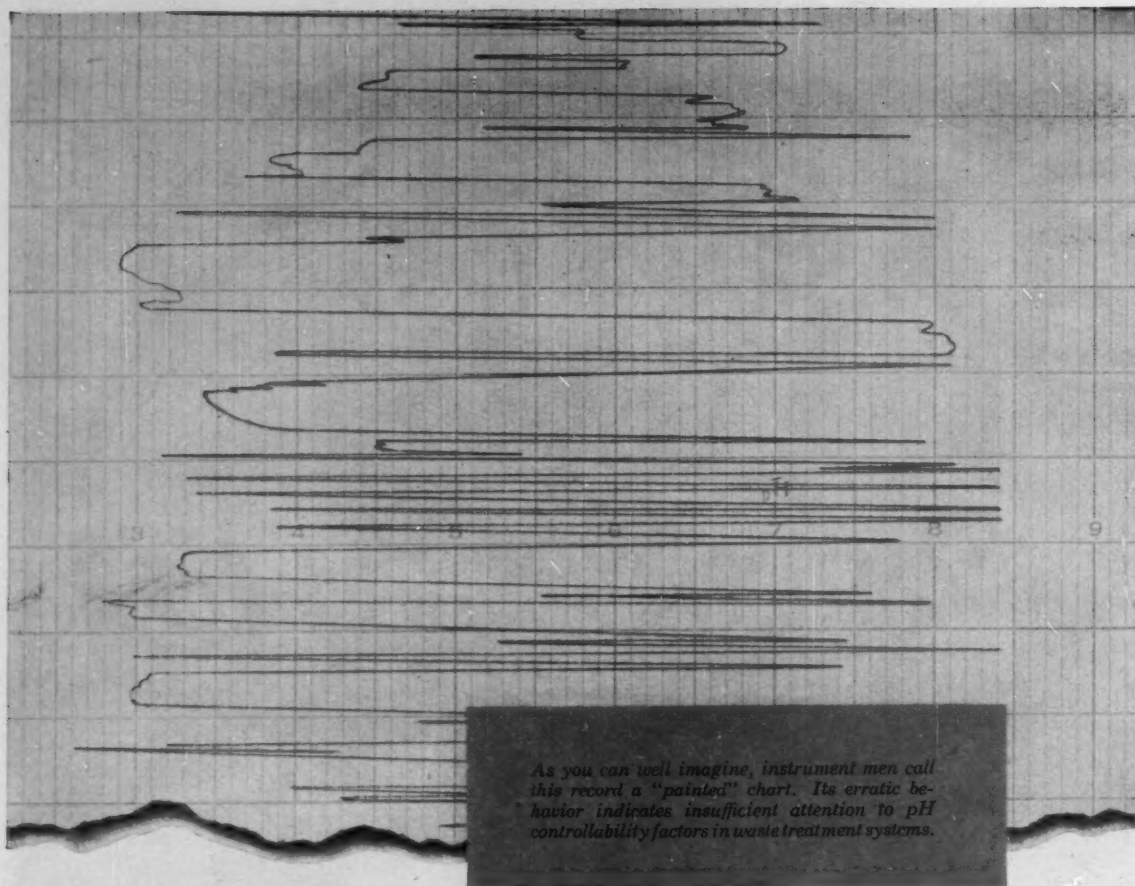
GUSTIN-BACON

Manufacturing Company



Thermal and acoustical glass fiber insulations • Pipe couplings and fittings • Molded glass fiber pipe insulation

252 W. 10TH ST., KANSAS CITY, MO.



FOR EFFICIENT WASTE TREATMENT

don't "paint" the chart!

In Any Given Waste Treatment System, the factors governing pH controllability—type of waste, variations in flow and concentration, layout and retention of the system, etc.—determine operational success. A painted chart may indicate that a system has been designed and instrumented without due regard to these factors, a regard which only L&N's pH Controllability Analysis provides.

This unique Analysis gives us vital information about the controllability factors of individual waste treatment processes. Our engineers analyze these data to determine the limits within which the process can be controlled in a proposed treating system, or to recommend the physical layout

needed to gain the desired degree of control—the answers you need to achieve efficiency in industrial waste treatment.

Process Data Sheet 700(2), "L&N Speedomax Control of Plant Waste Disposal Processes", outlines this approach to industrial waste treatment. Write for a copy and you'll also receive a Controllability Analysis Questionnaire to fill out and return, without obligation, for concrete answers to your specific waste treatment problem. The address—4916 Stenton Ave., Phila. 44, Pa.

Jrl. Ad. ND46-96(2)

LEEDS  **NORTHROP**
instruments automatic controls • furnaces

ERIEZ INTRODUCES NEW TYPE ELECTRO-PERMANENT MAGNETIC HI-VI VIBRATORY EQUIPMENT

**No Rectification . . .
Superior Performance . . .
Lower Operating Costs with
Exclusive "Double Action" Drive**



No other vibratory equipment like this! Eriez Magnetic "know-how" brings you the first complete line of Electro-PERMANENT Magnetic Unit (Bin) Vibrators and Feeders operating at 3600 CPM directly off an AC line. Just plug or wire them in . . . NO RECTIFIER NEEDED!

Look at these additional HI-VI advantages

LOWER MAINTENANCE and OPERATING COSTS . . . LONGER, TROUBLE-FREE SERVICE . . . VERSATILE UNITS PROVIDE BROADER OPERATING RANGES WITH LESS POWER CONSUMPTION . . . HI-VI UNITS ARE COMPACT, LIGHTWEIGHT, EASILY INSTALLED, NEED NO REALIGNING . . . NO SLIDING OR ROTATING PARTS TO WEAR . . . No lubricants needed . . . Noise factor is reduced, working conditions improved . . . New type "double action" drive provides higher operating efficiency with low operating cost . . . Many HI-VI models are totally enclosed, weather-and dust-resistant.

HI-VI's operating principle

The Eriez HI-VI drive system, the heart of which is a lifetime powered Alnico V Permanent Magnet, in effect replaces rectifiers by providing an inherent magnetic rectification system which provides more operating forces, no lost efficiency; all energy (two-way push-pull vibrating action) goes for productive performance.



HI-VI Vibratory Feeders . . . for accurate, controlled feed

Vibramatically convey, spread, agitate, separate, blend, dry, cool and mix bulk materials economically in little space and at most any desired speed . . . from ounces to tons per hour! For all types of materials: dry, hot, dusty, lumpy, abrasive, etc. Faster processing at greatly reduced operating costs.

HI-VI Unit (bin) Vibrators . . . keep materials flowing freely

Versatile units are AUTOMATICALLY SELF-ADJUSTED according to load requirements, eliminate pile-ups, sticking, bridging and arching of bulk materials flowing from or through containers. Exclusive HI-VI double diaphragming (kneading) action keeps materials pouring smoothly and evenly through hoppers, bins, chutes, etc.



HI-VI is the newest product of the Eriez Manufacturing Company, pioneer producer of permanent-powered magnetic separators for industry. Eriez HI-POWR Magnets are used to purify, retrieve and separate in processing lines of all types, and are available in a wide range of styles and sizes.

ERIEZ MANUFACTURING COMPANY
74D MAGNET DR., ERIE, PA.

Please send information on the new HI-VI vibratory equipment to:

NAME

COMPANY

ADDRESS

CITY STATE



IN ADDITION TO HARSHAW BORON TRIFLUORIDE HYDROFLUORIC ACID *anhydrous . . . aqueous*

Here are many more production-controlled, high-quality fluorides:

Ammonium Bifluoride	Hydrofluoric Acid
Ammonium Fluoborate	Aqueous
Antimony Trifluoride	Hydrofluosilicic Acid
Sublimed	Lead Fluoborate
Barium Fluoride	Metallic Fluoborates
Bismuth Fluoride	Potassium Bifluoride
Boron Trifluoride	Potassium Chromium
Boron Trifluoride	Fluoride
Complexes	Potassium Fluoborate
Chromium Fluoride	Potassium Fluoride
Copper Fluoborate	Potassium Titanium
Fluoboric Acid	Fluoride
Fluorine Cells	Silico Fluorides
Fluorinating Agents	Sodium Fluoborate
Frosting Mixtures	Tin Fluoborate
Hydrofluoric Acid	Zinc Fluoborate
Anhydrous	Zinc Fluoride

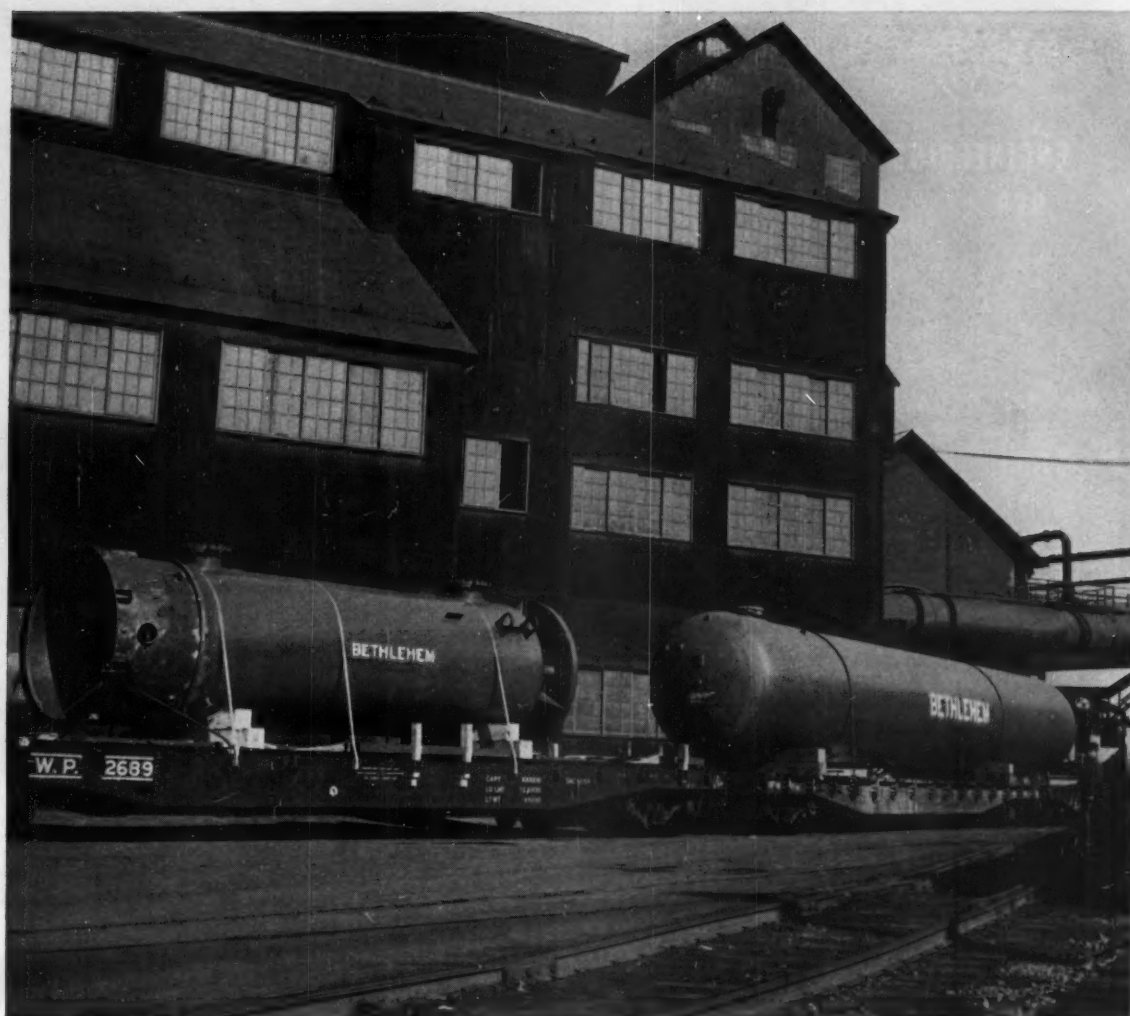
THE HARSHAW CHEMICAL CO.

1945 East 97th Street • Cleveland 6, Ohio

Chicago • Cincinnati • Cleveland • Detroit • Houston
Los Angeles • Hastings-on-Hudson, N. Y. • Philadelphia
Pittsburgh

WRITE FOR

Harshaw's 40-page Book
on Hydrofluoric Acid
Anhydrous. It provides
helpful data.



Absorber Tower — Propane Tank

Modest in size, as modern refinery vessels go, is the sponge oil absorber tower on the flat car at left. Only 27 ft in overall length, it weighs 21 tons, measures 84 in. ID, has 1-in.-thick walls and contains five bubble trays. One of fifty-odd vessels being fabricated by Bethlehem for a giant oil refinery, it hardly compares in size or complexity with others now under construction in our shops. Some of these measure up to 132 ft long by 132 in. ID, and tip the scales at 126 tons.

The more imposing vessel, appearing at the right in the picture above, is a propane tank fabricated

for another customer. It's our standard 30,000-gal tank, 67 ft long and 9 ft OD. We make them much bigger, however; in fact, we have a number in progress of 90,000 gals capacity.

Our point is this: that we are well able to handle your requirements for welded vessels, tanks and towers for chemical and petroleum processing. May we discuss the matter with you? Kindly get in touch with the Bethlehem steel office nearest you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

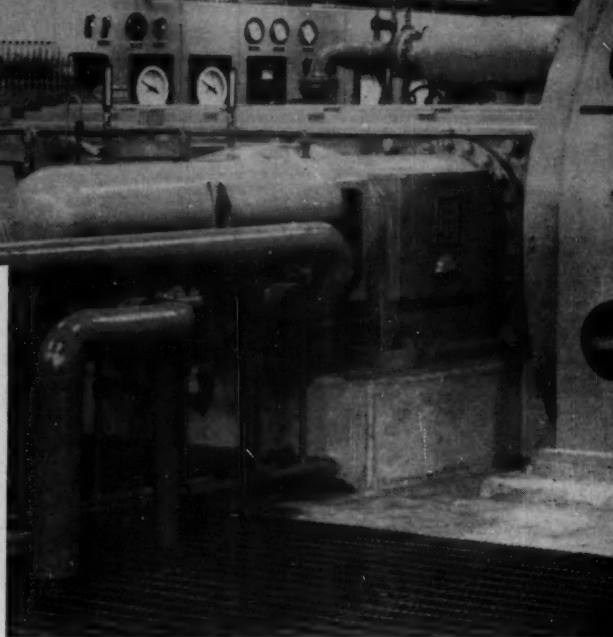




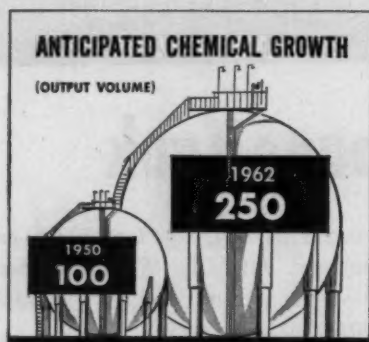
ENGINEERING REPORTS:



VICE PRESIDENT and plant manager J. C. Carriere (standing), discusses plant features with General Electric's H. F. Hemker, Grace Plant Superintendent Charles Dougherty, and G-E Service Engineer John Thrithart.



Grace Chemical* Installs Prepare New \$20,000,000



BY 1962, it is expected that the chemical industry will more than double 1950 production levels. In graph, 1950 production equals 100.

Source: Manufacturing Chemists Assoc.

General Electric Engineering Services helped Grace Chemical design, install flexible electrical system to handle present and future power loads

*Grace Chemical Co., division of W. R. Grace & Co.

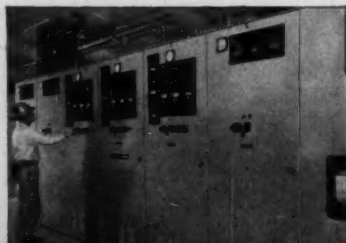
PLANNING NOW for future production is a major consideration in the fast-growing chemical and allied products industry. This booming industry is growing at the rate of about 7% per year (all industry growth averages only 3%) and the annual value of chemical products is now over 7% of the value of the nation's entire manufacturing output.

THE GRACE CHEMICAL COMPANY, a division of W. R. Grace & Co., anticipated growth and constructed the new ammonia-urea plant at Memphis, Tenn. Now in operation, the plant, described as one of the most modern in the industry, has an engineered electrical system that was planned to meet present

INCOMING POWER is "stepped down" by three G-E 7500-kva, three-phase, power transformers in the main substation. Whole plant uses grounded neutral system.

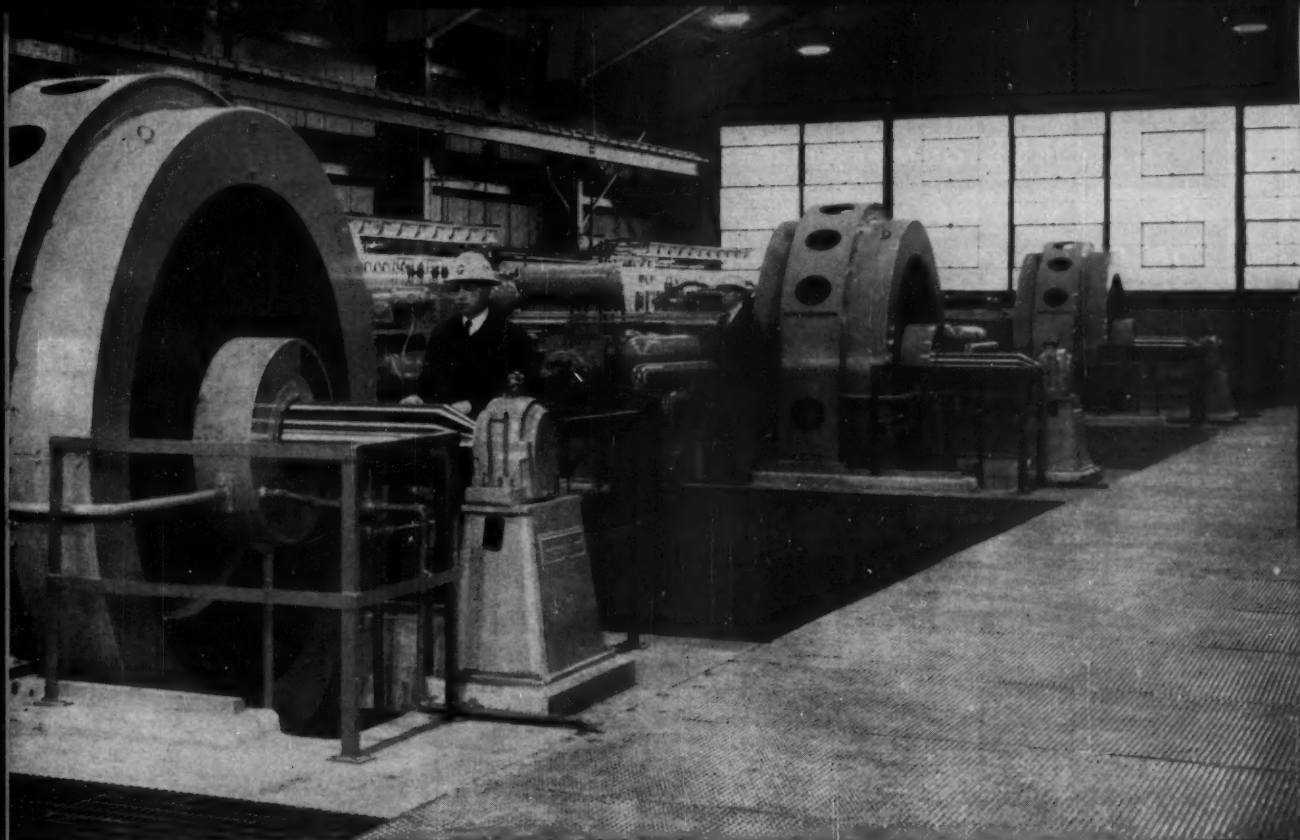


COST SAVINGS and operating convenience were obtained by locating 12,500-v. switchgear (below) inside, transformers (photo at left) outside the powerhouse.



POWER is stepped down to 480 volts for the plant's process drives by this 1000-kva load-center unit substation, one of four installed in the plant.





ONE OF THE OLDEST industrial chemicals, ammonia, has found new uses in synthetic fibres, vitamins, rocket and missile fuel, and vari-

ous chemical intermediates. In Grace's modern process, three huge 3000 hp G-E motors drive Ingersoll-Rand gas compressors.

Engineered Electrical System to Help Plant for Rapid Industry Growth

production requirements yet flexible enough for future expansion.

Cornerstone for expansion is the electrical system—designed and installed with the help of G-E engineering. A G-E service team headed by W. A. Raines, Manager—Industrial Sales, N. Y., and H. F. Hemker, Manager, G-E Memphis Office, worked closely with the Foster Wheeler Corp., main contractors, and Grace Chemical personnel to design and install the G-E electrical equipment that met the Grace requirements.

VICE PRESIDENT JOHN G. CARRIERE of the Grace Chemical Co., Plant Manager of the new installation, summed up a discussion of the plant facilities with

these words . . . "G-E engineering services did an excellent job for us; the electrical system has performed superbly."

WHEN YOU EXPAND OR MODERNIZE, G-E. has complete engineering services that will help you co-ordinate an electrical system designed for your specific needs. These specialists work with you

and your consultants to prepare your plant for present and future production requirements. Get in touch with your nearest G-E Apparatus Sales Representative early in your planning and write for bulletins GED-1966B and GED-2244 to General Electric Co., Section 681-10A, Schenectady 5, N. Y.

†Registered Trademark of General Electric Co.

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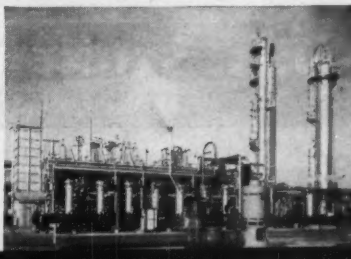
CONTROL for G-E compressor motors is provided by 4160-kv, metal-clad switchgear. Other electrical equipment also receives power through this line-up.



EASILY EXPANDED G-E motor control centers are co-ordinated with switchgear to provide complete selective tripping for the electrical system.



WATER-WELL PUMP is driven by 60 horsepower, G-E Tri-Clad† vertical motor. In the background is Grace Chemical Company's gas mixing equipment.



THE FIRST COMPLETE PACKAGE-TYPE FUME WASHER

IN STANDARD SIZES . . . AT LOWER COST!

The Cyclonaire

-only a fraction the size of custom
built units of comparable capacity

The new Cyclonaire, though only a fraction of the size, offers more fume removal capacity per dollar of cost than any custom-built unit of comparable capacity. The first complete "packaged" fume washer, it is made in four standard models with capacities ranging from 750 c.f.m. to 6,500 c.f.m. (Larger sizes on special order.) Outside dimensions range from 20" o.d. x 8'9" high to 48" o.d. x 14'7" high. Power requirements are low, and the compact design permits placing it almost anywhere in the plant. It will handle most corrosive gases normally encountered in fume scrubbing operations, with removal of many gases (of 1% concentration or less) up to 99.9% effective.

In operation the Cyclonaire is a wet bed scrubber . . . and the secret of its high efficiency is the bed of Intalox Saddles with which it is packed. Intalox Saddles provide greater randomness of packing and more contact surface area to water and fumes — hence more thorough scrubbing action — than any other industrial tower packing, volume for volume.

The Cyclonaire is constructed of steel in flanged sections which are easily assembled in a few hours — or disassembled and relocated in a comparably short time. Inner surfaces are protected from corrosion by a 3/32" thick Tygon sheet lining. Outer surfaces are protected with Tygon "ATD" Hot Spray Corrosion-Resistant Paint.



■ If you have a fume, dust or mist problem it will pay you well to . . . Take a look at the data . . .

252-E

PROCESS EQUIPMENT DIVISION

U. S. STONEWARE

AKRON 9, OHIO

Send for Bulletin FW-4. Get the complete story on this more efficient yet less expensive, space saving method of fume elimination.



• Chementator

H. T. SHARP

✓ Though the company declines to comment for now, Eastman Kodak is reported piloting a German-developed low-pressure polyethylene process — not Ziegler's.

✓ Look for Catalytic Construction to build the country's first uranium-from-lignite plant. Only the lack of an AEC price schedule delays final contracts.

✓ Stanford Research Institute is now developing a non-aqueous, electrochemical process for hydrazine. One big problem to be licked involves controlling formation and dissociation rates.

✓ Electrolytic perchlorate is being made with lead dioxide, not platinum, anodes in American Potash's pilot plant. If successful, use of perchlorate in propellants will rise.

Uranium-from-phosphate process told

Recent declassification of raw materials processing information by the Atomic Energy Commission will enable International Minerals & Chemical Corp. to lift the wraps from its long-hushed uranium-from-phosphate-rock process.

Installed two years ago as part of its phosphate operations at Bonnie, Fla., (*Chem. Eng.*, June 1954, p. 118) the uranium operation has been modified considerably since that time. Now, weak phosphoric acid from the main plant (*Chementator*, Mar. 1956, p. 108) passes over iron to lower the valence of uranium present. Acid and solvent (the dioctyl ester of pyrophosphoric acid in kerosene) are mixed and then separated by centrifuging.

After extraction, acid goes back to the phosphate plant and the organic fraction is treated with hydrofluoric acid to precipitate uranium tetrafluoride. Process details are now being released to *Chemical Engineering* and will appear next month.

New CO₂ absorber cuts steam need

By adapting to its ammonia process an absorption process first developed by the Bureau of Mines for Fischer-Tropsch synthesis gas, Chemical Construction has made a "substantial" cut in steam requirements of Es-cambia Bay Chemical Corp.'s new ammonia plant at Pensacola, Fla.

Ordinarily, an organic absorbent such as monoethanolamine is used to remove carbon dioxide from the hydrogen gas stream before it goes to the ammonia converter. Then steam is needed to regenerate the absorbent.

Chemico uses a 40% solution of potassium carbonate at about 200 F. as its absorbent. The absorption tower is held at around 300 psig. and, with the heat of absorption raising the temperature, 200-275 F. The solution then passes to the regenerating column where

the pressure drops to near-atmospheric and the CO_2 comes off.

Chemico says that it needs a more elaborate gas-liquid contacting system than was required for the original Bureau of Mines process (*Chem. Eng.*, Feb. 1953, p. 138) because ammonia synthesis has a lower tolerance for CO_2 than does Fischer-Tropsch synthesis. While patents are pending the company won't discuss details, but it claims that its scrubber cuts carbon dioxide concentration by 97-98%.

Reading new electrothermic processes

With construction now underway on a \$2-million pilot plant and an important corporate acquisition now completed, Strategic-Udy Metallurgical and Chemical Processes Ltd. is moving its new electrothermic processes closer to commercialization.

To be completed by fall, the new pilot plant at Niagara Falls, Ont., will first make three varieties of ferromanganese from low-grade (down to 4% Mn) ores. Later its four 1,000-kw. electric furnaces will be used for experimental calcium carbide production (*Chementator*, Oct. 1955, p. 103), iron ore smelting, chrome recovery from low-grade ores, nickel recovery from asbestos tailings and alumina recovery from red mud. These processes were all devised by Marvin J. Udy, Niagara Falls (N. Y.) consultant, and have shown considerable promise in lab tests.

The new acquisition—Comstock and Wescott, a Niagara Falls, N. Y., consulting and testing firm—will play an important role in developing these processes. While continuing to offer its services to industry as in the past, C&W will supply research and development personnel to run the new pilot unit.

In Udy's ferromanganese process, New Brunswick ore averaging less than 12% manganese is calcined at about 2,000 F., then charged, together with coke and lime, to a novel electric furnace. Smelting at 1,000 kw. and 130 v. separates most of the iron and gives a 22% manganese slag. Hot, molten slag goes directly to a second furnace where more coke and lime are added to make high carbon ferromanganese (FeMnC).

The hot, molten slag is also smelted with silica and coke to make ferromanganese silicon (FeMnSi). This can either be marketed as such or used with lime to smelt another portion of hot slag, making medium or low carbon ferromanganese.

Phosphorus in the ore and manganese volatilization in the furnace offer major problems in smelting. Udy adds either FeMnSi or FeMnC to the ore smelting furnace as a reducing agent. This concentrates virtually all of the phosphorous in the iron, which is removed, and it also gives a high manganese-low phosphorus slag used for further processing.

Furnace details have not been revealed, but Udy claims that his design and operating techniques all but eliminate volatilization—providing economical recovery of 90-95% of the manganese in the ore. An 80-85% recovery is common with other processes.

Lab tests have been run on a number of ores of varying manganese content. Udy reports that upgrading averages about 20 percentage points. Even ordinarily blast furnace slag has been used. Results are termed successful and costs would be in line if Udy's unit were beside the blast furnace.

How many A-bombs for Britain?

Recent disclosures on the approximate plant capacities of Britain's Windscale and Cappenhurst nuclear facilities—buried in a talk on solvent extraction techniques—have been combined with earlier estimates to yield a "guesstimate" on the size of Britain's atom bomb stockpile.

Observers use a remark of Sir Christopher Hinton, head of the Atomic Energy Authority, that "hundreds of tons of uranium are processed yearly at Windscale to yield hundreds of kilograms of plutonium" as their starting point. They then add the knowledge that each ton of uranium passing through Windscale reactors contains 7 kg. of U_{235} , and the fact that solvent extraction recovers 0.1 kg. of plutonium per kg. of U_{235} .

Since an A-bomb is believed to need about 5 kg. of plutonium, this would mean about 15 bombs per ton of uranium. Prior estimates of Windscale's appetite for uranium—based mostly on external features—set it at 700 tons/yr. That means that its stockpile contribution runs about 300-500 bombs per year.

Less is known about the Cappenhurst thermal diffusion plant. But programmed demands for the Dounray reactor would place its annual production at the equivalent of about 600 bombs.

(Continued on page 108)



INSIDE STORY:

Why a Heat Exchanger Poses for an X-ray

This technician is giving a clean bill of health to a completed weld on a P-K heat exchanger. Like the x-ray of your chest, this x-ray picture is designed to pick up flaws before they have a chance to become harmful.

Pinholes, lamination, slag inclusions, and all other symptoms of failure are ruled out by this process, which is used to scrutinize the "inside" of every weld. Such radiographs are indispensable in manufacturing pressure vessels that will meet every test of time and use. Each x-ray is checked by a representative of the Hartford Steam Boiler Inspection and Insurance Company—for further insurance that every P-K heat exchanger meets or exceeds the rigid standards of the 1952 ASME Code for Unfired Pressure Vessels.

But weld x-rays at P-K represent only a precaution.

They don't speak for the fact that all P-K welders are ASME qualified for a total of more than 50 types of welding procedures—meaning that the likelihood that flaws will occur at all is minimized. Nor can you see in an x-ray photo the incredibly careful design and calculation that goes into every P-K pressure vessel, to assure that it will be *thermally* and *physically* correct in every way.

Add this all-important knowledge of thermal design to P-K's fabricating and testing procedures, and you have what makes P-K heat transfer equipment different—and better—than all the rest.

Like proof? We'd be delighted to receive your inquiry. The Patterson-Kelley Co., Inc., 140 Lackawanna Ave., East Stroudsburg, Penna. Offices in principal cities.

PATTERSON KELLEY

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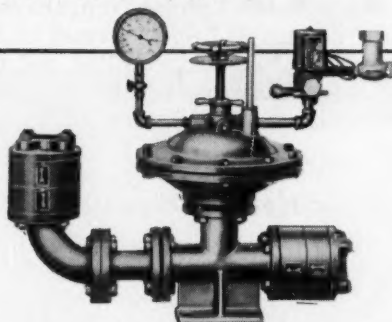
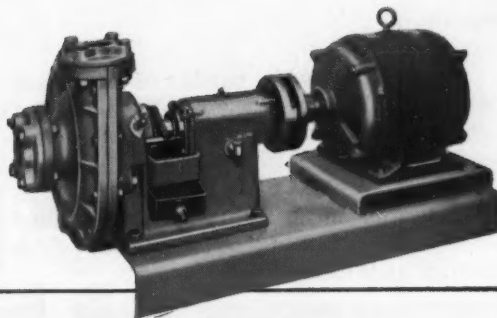
Heat Exchangers • Convertors • Storage Water Heaters • Condensers • Water Chillers • Oil Heaters • and all types of heat transfer equipment

CHEMICAL ENGINEERING—April 1956

105

OLIVITE® Acid Handling Pump

An efficient, durable pump for handling hot or cold acids and corrosive solutions. Special rubber or neoprene base composition covers casing, cover and impeller. It does not crack or slough off even under high temperatures. Sizes available — 1½", 2" and 4". Write for Bulletin No. 308-R2.

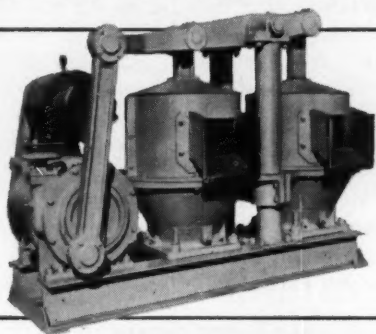
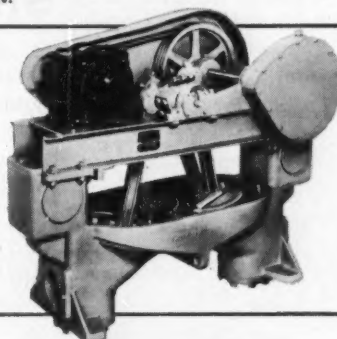


OLIVER Diaphragm Slurry Pump

This pump is designed to operate without mechanical linkage for transmitting force to diaphragm — source of power is compressed air. There is no motor, stuffing box or packing. Capacity quickly changed from zero up without stopping operations. Pump can be shut off while running. Six sizes available. Write for Bulletin No. 309-R.

DORRCO Type V Pump

For removing underflows from Thickeners and Hydro-separators by positive displacement. Twin pumping chambers with individual suction and discharge connection for each chamber. Adjustable stroke while pump is running. Six sizes to handle up to 30 cu. ft. of pulp per minute. Write for Bulletin No. 5001.

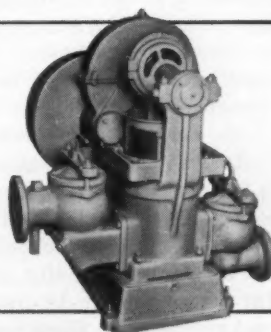


DORRCO Type W Pump

A rugged duplex diaphragm pump designed for big tonnage operation featuring variable stroke adjustment while pump is running. Available in 6" and 8" models to handle up to 75 cu. ft. of pulp per minute. Write for Bulletin No. 5002.

DORRCO Plunger Pump

A dependable unit for pumping sludges in municipal and industrial water and waste treatment plants. Adjustable eccentric permits stroke variation of 1" to 5". Can be controlled by program time clock for optimum 24-hour operation. Write for Bulletin No. 5182.



DORR-OLIVER

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Multiplying by the number of years each reactor has been in use gives the estimated 2,300 to 4,000 bombs observers think are in the stockpile.

More reliable is the information in Hinton's talk that nitric acid in a dibutyl carbitol solvent is used to extract plutonium from uranium at Windscale.

Jersey tries fixed bed reforming

A pioneer in fluid bed technology is now betting some \$60 million on the success of a newly developed fixed bed petroleum reforming process. Developed by Esso Research and Engineering Co. the new technique, called Powerforming, will be tried by Standard Oil Co. (N. J.) affiliates throughout the world.

Three units are already in operation—at Edmonton, Can., Billings, Mont., and Baltimore, Md.—and 13 more are set for other sites. They range in capacity from 1,000 to 26,000 bpd.

Since patent applications are still pending, Esso is tight-lipped on process details. About all that the company is willing to say is that the process is somewhat similar to Standard of Indiana's Ultraforming (*Chem. Eng.*, Jan. 1954, p. 132) in which it has an interest. Major differences involve catalyst composition and the regenerating system.

Esso says that the catalyst is a new type, using very little platinum. Efficiency of the regenerating system is such that the catalyst may be re-used almost indefinitely.

Progress in processing with intense arcs

At a recent symposium at the Polytechnic Institute of Brooklyn, Samuel Korman, coinventor with Charles Sheer of a technique for carrying out chemical reactions at high temperatures, gave a report on the method.

As described here earlier (*Chementator*, Sept. 1954, p. 106), Korman and Sheer generate temperatures in the 15,000-20,000 F. range at the tip of an anode made by mixing a little carbon with the material, usually an ore, being processed. Current input and density are boosted to the point where the anode crater covers the entire end surface. At these temperatures the material actually boils. Its components are then condensed successively.

Originally, work was confined to beryl ores. Now, it involves rhodonite (for manganese), spodumene (for lithium), illmenite (for

titanium) and euxemite (for uranium and rare earths). Where the original process used an ore anode, a graphite cathode and direct current, present studies involve two ore electrodes and alternating current—in effect a double furnace.

Light Metals Refining Corp., the company which Korman and Sheer formed to develop the method has been dissolved and current studies are taking place in the labs of another firm—reliably reported to be Vitro Corp.

New sugar process claims lower costs

Higher yields and lower operating costs are the major claims for the new sugar processing techniques now being developed by Ultra-Sucro Co., New York. In addition, the company says that the raw sugar product is easier to refine and the byproduct molasses is pure enough for human consumption.

Just-ended tests, held under plant conditions, show increases of 12-15% in the amount of raw sugar extracted from the cane—with operating costs 95% lower than usual. These results have stirred strong industry interest and Ultra-Sucro is now considering building a demonstration mill in the U. S.

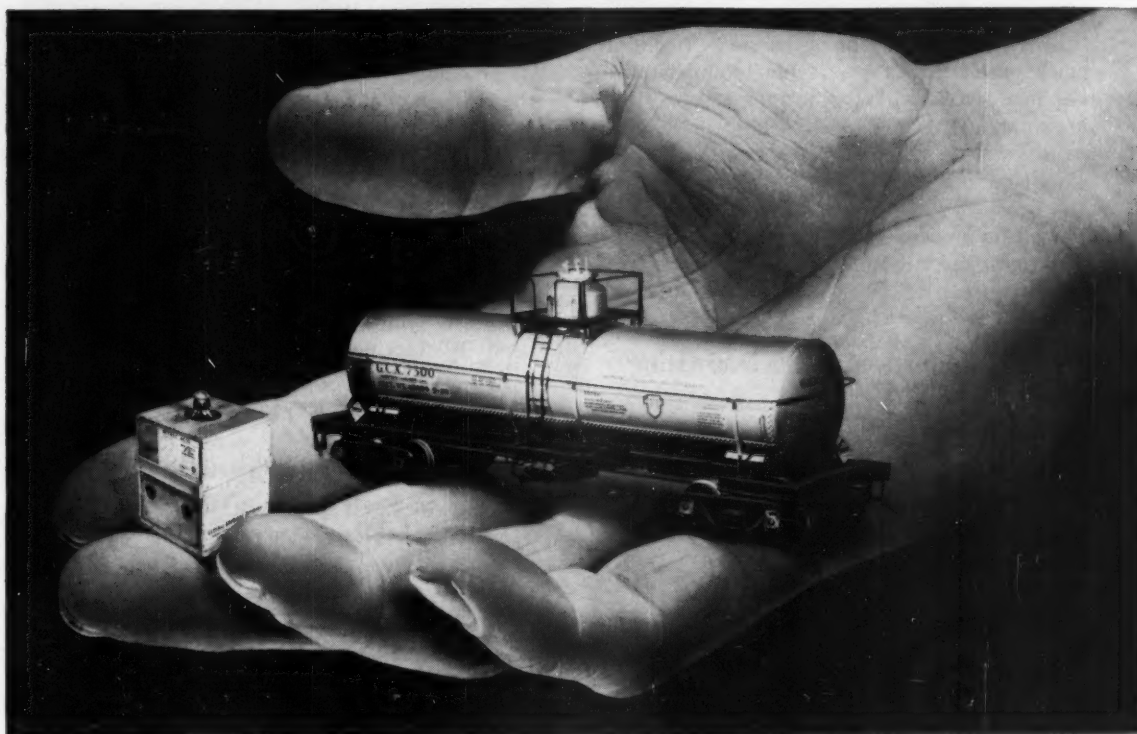
Part of the increased yield comes from using a more effective hydraulic method of maintaining uniform pressure in the juice extraction mills. But a new method of removing mineral salts and ash material is the major improvement. Ultra-Sucro will say little about the method for now. It was worked out in cooperation with a large chemical company and an engineering firm, and it does not involve ion exchange.

Kellogg drops option on Kurth process

M. W. Kellogg has finally decided to drop its option on the wax-from-bark process first worked out by E. F. Kurth at the Oregon Forest Products Laboratory, Corvallis, Ore. The Oregon State Forestry Board will now make the process available to others.

The Kurth process solvent-extracts about 150 lb. of high quality wax, 150 lb. of tannin and 100 lb. of dihydroquercetin from each ton of Douglas fir bark. Kellogg has spent three years developing the process—pilot planting extraction steps at Wilson, Ark., and refining the product at its Jersey City plant. Some
(Continued on page 110)

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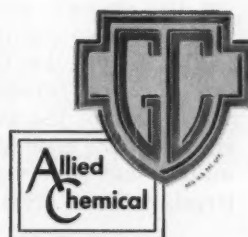
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5,000 lb. of wax have already been test-marketed.

The high-gloss, high-melting point wax has excellent solvent binding power and acceptable hardness and it won a ready reception from users. In fact, up until the decision to drop the option was finally made, it was widely believed that Kellogg would soon announce a plant—for either Coos Bay or Eugene, Ore.

What caused the reversal? Declining price of Carnauba wax, chief competitor of the new wax, is likely the main factor. Kellogg planned on a 75¢/lb. selling price. Carnauba's slide to 60-70¢/lb. ruled that out. This clouding of the wax's profit picture and the bright prospects for its recently licensed polyolefin process probably prompted Kellogg to revamp its thinking on where to spend its money.

Piloting high-speed wood laminating

A new wood laminating technique which runs counter to accepted theories of adhesive action on wood is now being successfully pilot planted by Potlatch Forests, Inc., Lewiston, Idaho. The new method upgrades inferior lumber and it's likely to result in wider use of phenolic resin adhesives.

In the pilot plant, a radiant heater raises the surface temperature of the kiln-dried wood to 310-350 F. in about 60 to 120 sec. A nozzle-type glue spreader coats the surfaces to be joined and 60 sec. in a 200-psi. press makes the joint. With older methods bonding takes about four hours.

Washington State College researchers who developed the process feared that applying the phenolic resin adhesive to the hot surfaces would result in precuring and poor joints. In practice they find that whatever precuring does take place occurs chiefly below the surface of the wood while the unreacted surface of the resin films make the bond. This means that the resin-to-wood links form largely without pressure.

Three ways to make low-calcium brine

A rock salt that yields low-cost, low-calcium brine is the first major product developed by Morton Salt's new Woodstock, Ill., research lab. Tailored for textile and chemical industry jobs, the new brine's calcium content is less than 25% of that of ordinary rock salt brine.

In general, Morton adds phosphates and

carbonates to rock salt to suppress calcium sulfate solubility. But the patented (U. S. 2,433,601) process can take one of three different routes to a low-cost product.

- Adding sodium orthophosphate (or metaphosphate for certain conditions) to the water sent down into brine deposits to bring up the salt. Cost of this method is about one cent per ton of salt, compared to 25¢ to \$1/ton for purifying by chemical precipitation.

- Adding the chemical to the solution as the brine is made up.

- Pelletizing the additives with salt and distributing the pellets throughout the proper amount of salt. This is Morton's "PCB" rock salt product. It commands a \$1/ton premium over ordinary rock salt.

Used in dyeing textiles, this brine reduces the need for sequestering agents, eliminates streaking and improves color intensity. When used in chlorine-caustic cells, it produces a high-purity caustic.

Slight cell changes boost output

Set to be installed in its now-building \$11-million chlorine-caustic plant at Vancouver, B. C., Can., Hooker Electrochemical's modified cell design is also catching on with other cell users. Westvaco Chlor-Alkali Div. of Food Machinery and Chemical Corp. expects to use several hundred in its South Charleston, W. Va., plant to replace several thousand of an older design, and Hooker is now negotiating with several other firms.

With chlorine demand growing and plant floor space generally at a premium, many electrolytic chlorine makers have taken to running their units well above design capacity to raise output. But liquid entrainment in the chlorine gas stream has limited the amount of current which they can use in their cells.

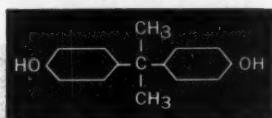
To get around this difficulty, Hooker made some design changes in its widely-used cell—the most important involves increasing the liquid disengaging space at the top.

The modified cell, tabbed Type S 3-B, is now rated at 30,000 amp. instead of the 25,000 amp. of earlier units. This boosts chlorine-caustic output by some 20%—to about one ton of chlorine per cell per day. And, since only cell height is changed, floor space is conserved.

For more of WHAT'S HAPPENING . . . 113

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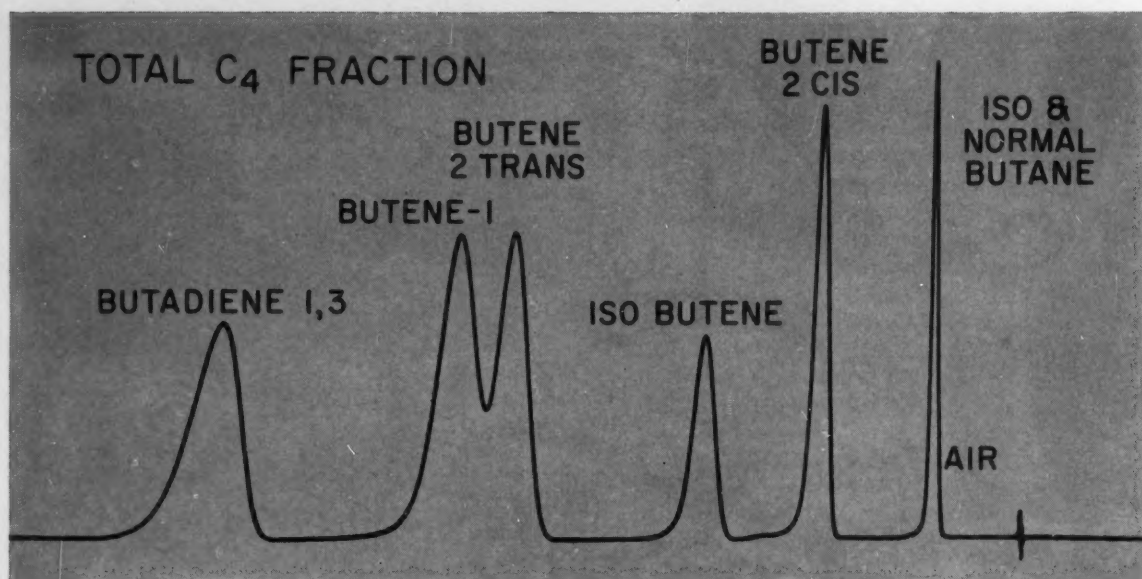
Shell Bisphenol A is supplied in flake form, packed in multiwall 50-pound bags for ease of handling. Your letter-head request will bring a sample for evaluation and a new technical bulletin.

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New P-E Model 154 Vapor Fractometer gives you

BUTENE SEPARATION IN 15 MINUTES!

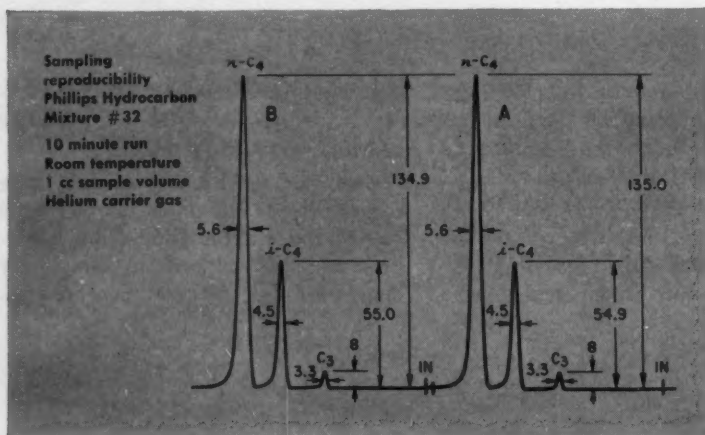
Analysis extremely difficult by ordinary methods

Employing the principles of gas chromatography, P-E's new Model 154 Vapor Fractometer is a revolutionary advance in the field of gas and volatile-liquid analysis. Quantitatively it is fast, precise, uncomplicated to operate, extremely simple in calculation, and above all, many times less expensive than distillation columns, mass spectrometer, or any other instrument for the purpose. Qualitatively the instrument gives extremely clean separations—even of components and isomers

which cannot be separated by ordinary methods.

The butene separation shown above demonstrates the instrument's ability to take advantage of the physical properties of the sample (in this instance, the chemical complexing with the stationary phase) to achieve the desired separation. Other column materials will readily resolve the paraffin hydrocarbons.

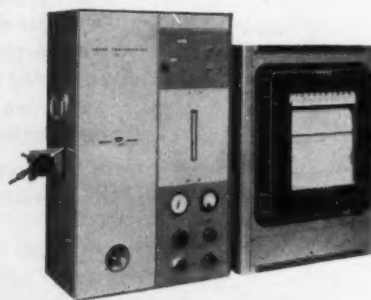
Vapor fractometry is the fastest, simplest, most inexpensive method of analysis in existence today.



The remarkable reproducibility of the Vapor Fractometer is shown in the two runs, A and B. Note that the quantitative values of A, B, and the Phillips analysis agree to small fractions of a percent.

MOLE % CONCENTRATION

	Run A	Run B	Phillips
Propane	2.56	2.56	2.55
Isobutane	24.00	24.05	23.98
N-butane	73.44	73.39	73.47



This is the Model 154 Vapor Fractometer—price, \$2200.00 including recorder. Send for descriptive bulletin.

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April 1956—CHEMICAL ENGINEERING

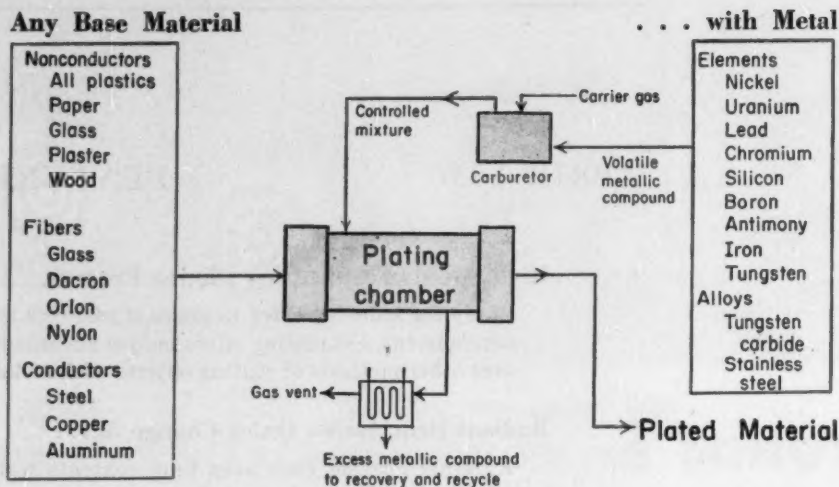
What's Happening

APRIL 1956

FEATURE NEWS

- **High Speeds Feature New Plating Process 114**
Ready for industry after 15 years of research and development, gas plating offers unique advantages over other methods of coating objects with metals.
- **Radiant Heat Assists Quick-Change Act 118**
External heating coils keep tank contents warm for easy pumping, leave interiors free for easy cleaning.
- **Tiny "Plant" Monitors Process Wastes 120**
Reading directly in ppm. of organic carbon, continuous, automatic analyzer helps Du Pont track down process losses, control content of waste streams.
- **Furfural Taps New Source 126**
First plant to make furfural from bagasse combines ideal location, guaranteed markets, technical savvy to achieve commercial success.
- **Rids Water of Radioactivity 130**
- **Stress-Relieved 200 Ft. Up 132**
Unusual requirements for heat-treating 25-ft.-dia. by 71-ft.-high tower section after erection called for novel technique, with the vessel serving as its own oven.
- **Product Mix Keyed to Demand 136**
New Los Angeles mixed fertilizer plant majors on simpler, lower-analysis granulated products in line with demands of specialized Western markets.
- **Convention Calendar 116**

Continuous Gas Plating of . . .



High Speed: Feature of New Plating Process

Ready for industry after 15 years of research and development, gas plating offers unique advantages over other methods of coating objects with metals.

Gas plating, a long known but little appreciated process, is now being groomed for commercialization by its most enthusiastic devotee, Commonwealth Engineering Co. of Dayton, Ohio.

According to President Malvern Hiler, Commonwealth is now ready, after 15 years and \$400,000 worth of research, to develop process flowsheets and design data for any specific commercial application. Work of this sort is already under way for several unnamed industrial sponsors.

In addition, the Army Chemical Corps last year set up and operated a pilot plant at Edgewood, Md., for nickel-plating glass fiber (see cut, opposite page). Running continuously and automatically at linear speeds of more than 100 ft./min., the fibers picked up metal coatings as heavy as 0.001 in. **►What Can It Do?**—Principle of gas plating is the thermal de-

composition of a volatile metal-containing compound at the surface of the object being plated. Gas plating can do almost everything that other plating processes—electroplating, hot dipping, vacuum metallizing—can do, plus more. CEC cites these unique advantages:

- **Plating speed is high.** For example, the new process can deposit 0.001 in. of nickel in only 3 to 6 sec. This deposition rate is 60 to 600 times faster than with electroplating.

- **No other method has successfully plated fibers,** e.g., nylon and glass.

- **Gas plating can deposit mixtures of metals as alloys,** e.g., stainless steel or tungsten carbide.

Project Supervisor H. J. Homer emphasizes that gas plating is not expected to compete directly with other plating methods. Rather, it will find its own specific fields of usefulness.

►How Does It Work?—The article to be plated—either a continuous length (fiber, wire, paper) or discrete objects on a conveyor—goes first through a zone where its surface is prepared for plating. Type of surface preparation depends on the material. Steel objects might be degreased, pickled; wire would be heated electrically in an atmosphere of hydrogen.

Metal-containing vapor (such as nickel carbonyl, b.p. 115 F.) enters the plating chamber on the current of an inert carrier gas. Here it comes in contact with the surface of the object to be plated, which has been heated to a temperature exceeding the decomposition point of the vapor (for nickel carbonyl, 365 F.). The metal atom deposits out of the vapor phase onto the object's surface.

To be sure that the deposition occurs right on the surface—that it doesn't merely "snow

out"—the chamber atmosphere is kept below the decomposition temperature. This is accomplished by sweeping the vapor through the chamber in large excess.

Unused vapor is condensed and recovered. Carrier gas (usually carbon monoxide) and exhausted vapor are vented. And the plated article passes to a cooling chamber.

► **How It Started**—Original work on this plating method was done by Ludwig Mond in 1890. Studying nickel ore processing, he passed carbon monoxide over the ore and came up with nickel carbonyl. As a vapor this compound dropped nickel powder out in a hot chamber.

Mond observed his "snow" nickel-plate wood and obtained a patent. But he was unable to devise suitable means of controlling the process. And the experiment retired, a chemical oddity, to a handful of textbooks.

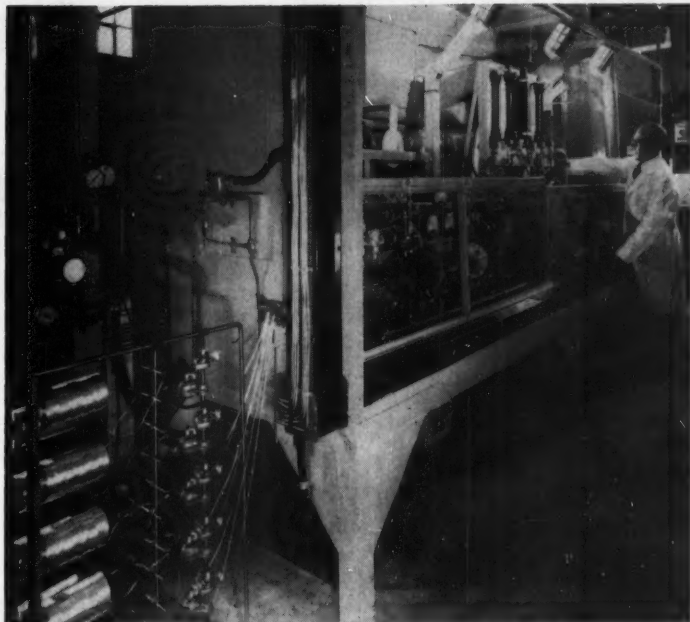
► **Out of Limbo**—Hiler tells how CEC licked Mond's problem:

"Our major contribution came the day we hooked on a piece of pipe and added a carrier gas. This meant that, essentially, we had a carburetor. We could make controlled mixtures of nickel carbonyl and carrier gas."

Nature, density and speed of plate are controlled by (1) concentration of metal compound in the carrier gas from the carburetor, (2) degree of turbulence of the plating chamber's atmosphere and (3) temperature of the object being plated. Further improvements by Homer's research team include better distribution and directional control of the vapor.

► **What Does It Cost?**—Hiler estimates that a development program of four to eight months will yield enough process design data for any particular proposed application of gas plating. Cost of this program might run from \$1,000 to \$4,000 per month.

Investment in a production unit, of course, would depend on the particular application and the scale of operation. Hiler figures, however, that a manufacturer could get into com-



GLASS FIBERS are nickel-plated in this Chemical Corps pilot plant.

mercial production with facilities costing as little as \$60,000.

To tie down probable operating costs is rather difficult. For the cost of materials alone, CEC cites the Chemical Corps' consumption for nickel-plating 45,000 miles of glass fiber: 75¢ worth of nickel carbonyl, 8¢ worth of carrier gas, 16¢ worth of electricity.

► **Stumbling Block**—Among the metallic compounds which CEC researchers have used successfully are, besides nickel carbonyl, tetraethyl lead and uranium hexafluoride. But they eye others that they would like to try, such as chromium hexacarbonyl and hydrides of silicon and boron.

Costs of some gas-plating chemicals are prohibitive. Price of chromium hexacarbonyl, for example, is about \$1,000 per lb. Some suppliers are reluctant to undertake research on these chemicals. Their reasons: Materials are too difficult to handle, electroplating is cheaper and less hazardous.

But Hiler sees no unbeatable handling problems, believes that proper research can cut chemical costs. Consequently, CEC has now ventured into its

own research program on gas-plating chemicals. And the firm has been able to convince others—Linde Air Products, Metal Hydrides, Arapahoe Chemical—that gas plating has a bright future.

What they're after are compounds that boil without decomposing, deposit pure metal upon decomposing and cost less than \$1 per lb. If you're looking for a challenging chemical research problem, here you are.

Three Oil Firms Pushing For Higher Octanes

Shell Oil, Socony Mobil Oil and British American Oil have all announced plans aimed at raising octane ratings of their gasolines.

Shell has already started up a plant in Anacortes, Wash., which uses a new two-stage fluid cracking technique to achieve a greater high-octane gasoline yield. It's designed for 23,000 bpd. intake. Shell has not yet disclosed further details on the process except to say that early operations have confirmed predicted benefits.

Construction has started on a

Socony Mobil catalytic reforming unit for upgrading motor gasoline in East St. Louis, Ill. British American plans to build a \$4-million catalytic reforming unit at its Clarkson, Ont., refinery. It will process about 10,000 bpd. of straight-run naphtha to be used as a high-octane blending agent in gasolines.

Rohm & Haas to Make Acetylene From Methane

Rohm & Haas' long-rumored capacity boost for acrylic raw materials (*Chem. Eng.*, Dec. 1955, p. 103) has finally been confirmed. The company has announced that it will put in additional units at Deer Park, Tex., to make acetylene via the BASF process. Already in commercial use in the U.S.—at American Cyanamid's Fortier, La., plant, at Texas City plants of Carbide and Carbon and of Monsanto, the process is based on partial oxidation of methane to supply heat for cracking additional methane to acetylene.

At Deer Park, Rohm & Haas will use byproduct gases from the acetylene plant to make ammonia and methanol for its own consumption. Chemical Construction Co. will build the acetylene plant, Foster Wheeler the byproducts plant.

Dow, Shell to Make Latex Out West

Dow Chemical will build a \$1-million styrene-butadiene latex plant in Pittsburg, Calif., while Shell Chemical is adding facilities at its Torrance, Calif., rubber plant to make cold high-solids latex. Production of the Dow plant, when operations begin this fall, will go primarily to surface coatings markets. Shell's output will be aimed at foamed-rubber uses.

Another Farm Co-op In Chemical Business

Central Farmers Fertilizer Corp., owned by 14 large farm groups in the North Midwest, has cleared the final obstacle to construction of a multi-million-dollar phosphate mine and reduction processing plant at

Georgetown, Idaho, with signing of a power contract with Utah Power & Light Co.

The plant's electric furnace, with a 35,000-kw. rating, will be one of the largest elemental phosphorus units in the country. Its entire output probably will go toward production of calcium metaphosphate. This is accomplished by slow burning of the element with raw phosphate rock.

Only a few months ago another farm co-op, National Farmers Union, announced the following tentative plans: A \$12-million, 125-ton/day anhydrous ammonia plant for central Utah; a \$5-million concentrated superphosphate and sulfuric acid plant, northern Utah; a granulated mixed-fertilizer plant in Salt Lake City.

U.S. Firms to Make Polyethylene in Brazil

W. R. Grace and Union Carbide and Carbon have both announced plans to produce polyethylene in Brazil. Grace is making its move in conjunction with Germany's Farbwerke-Hoechst A. G. of Frankfurt. They'll use the Zeigler low-pressure process in a new Sao Paulo plant. Carbide has not disclosed process to be used at its new plant, which is set for Cubatao, near Santos.

An added note on low-pressure polyethylene processes: Phillips Petroleum has just licensed its process to M. W. Kellogg and Societe des Usines Rhone-Poulenc of France. This is the process that Grace, too, will use in an \$18-million plant in the U. S. (see *Chem. Eng.*, Nov. 1955, p. 116).

The Grace-Hoechst combine is also currently building a \$6-million, 2,500-ton/yr. DDT plant in Sao Paulo. In addition, the plant will produce monochlorobenzene, caustic soda, solvents and detergents.

And Carbide has just put a new vinyl esters unit on stream in Niagara Falls, N. Y. Vinyl propionate, vinyl butyrate and vinyl 2-ethyl hexoate will be produced, making them available for the first time in tankcar quantities.

Convention Calendar

Eighteenth Annual American Power Conference, highlights nuclear power production, Hotel Sherman, Chicago, Mar. 21-23.

National Assn. of Corrosion Engineers, annual corrosion control short course, University of Oklahoma Extension Study Center, Norman, Okla., Apr. 3-5.

American Chemical Society, 129th National Meeting, Statler Hilton Hotel, Dallas, Apr. 8-13.

Midwest Research Institute, "Symposium for Management on Applications of Analog Computers," University of Kansas City, Mo., Apr. 10-11.

American Management Assn., Silver Anniversary Packaging Exposition, Convention Hall, Atlantic City, N. J., Apr. 9-12.

Metal Powder Assn., 12th annual meeting and 1956 Metal Powder Show, Hotel Cleveland, Cleveland, Apr. 10-12.

Armour Research Foundation, first annual national industrial research conference, "Research for Profit," Sherman Hotel, Chicago, Apr. 18-19.

American Oil Chemists' Society, 47th annual spring meeting, Shamrock Hotel, Houston, Apr. 23-25.

Assn. of British Chemical Mfrs., Chemical Section of British Industries Fair, National Hall, Olympia, London, Apr. 23-May 4.

Assn. of Consulting Chemists and Chemical Engineers, banquet and symposium on "The Story of Fermentation," Hotel Belmont Plaza, New York, Apr. 25.

American Institute of Chemical Engineers, national meeting, including symposia on "Foreign Developments and Their Effect on the U.S. Chemical Industry" and "Liquid Metals," Roosevelt Hotel, New Orleans, La., May 6-9.

Chemical Market Research Assn., "The Chemical Industry: Review and Forecast," Biltmore Hotel, New York, May 14-15.

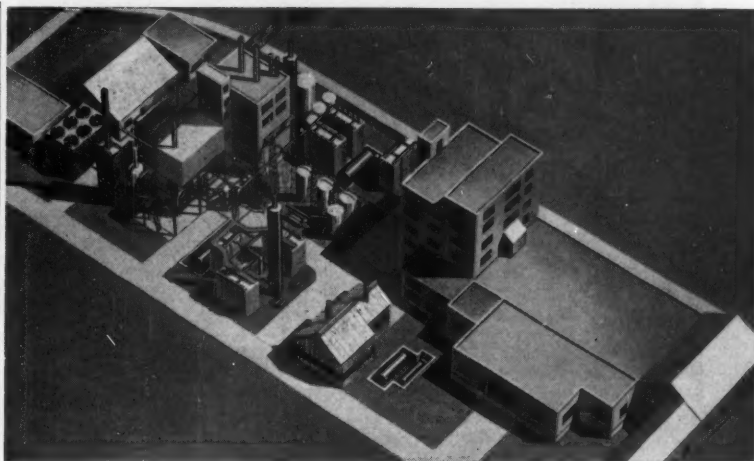
Lummus-Built Plant Will Double Phthalic Capacity For Pittsburgh Coke & Chemical

Paint and Plastics Producers to Benefit From Expansion

To double the phthalic anhydride capacity of Pittsburgh Coke and Chemical Company's Coal Chemicals Division, The Lummus Company is engineering and constructing a \$3,000,000 plant on Neville Island in the Ohio River below Pittsburgh. The new plant, to be completed by Fall 1956, is a further step in Pittsburgh Coke's chemical expansion.

This second installation is being built because plasticizer and alkyd resin manufacturers need more phthalic. Since 1949, vinyl plastics consumption has risen 100%; alkyd resin paints 50%; polyester plastics 400%. Phthalic, as a basic raw material for these industries, is in ever-increasing demand. Increased phthalic consumption by Pittsburgh Coke and Chemical's own Plasticizer Division has also been a major factor in the company's planning.

As a result of its long chemical experience, Lummus is well



Artist's conception of expanded facilities.

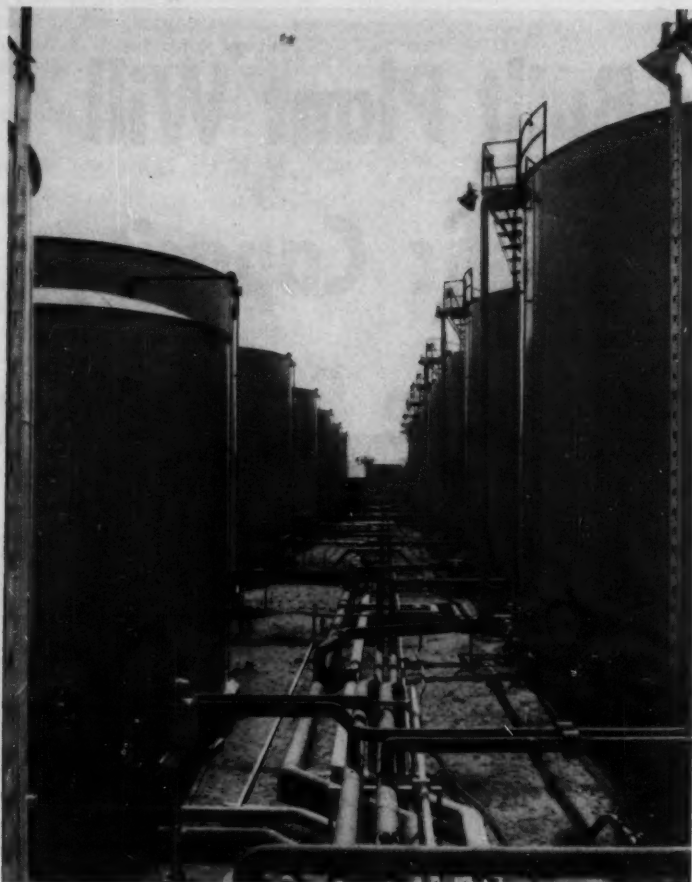
equipped to carry out this project for the manufacture of phthalic. The new facilities will incorporate many improvements in production efficiency and product purity.

Other current chemical projects at Lummus include ammonia and ammonia products installations, a vinyl acetate unit and acetylene derivatives facilities. And our books show hundreds of completed plants for a wide range of products from ethylene through butadiene.

When you plan your next plant, call on Lummus—designing engineers and constructors for the petroleum and chemical industries.

The Lummus Company, 385 Madison Avenue, New York 17, N. Y. **Engineering and Sales Offices:** New York, Houston, Montreal, London, Paris, The Hague, Bombay. **Sales Offices:** Chicago, Caracas. **Heat Exchanger Plant:** Honesdale, Pennsylvania. **Fabricated Piping Plant:** East Chicago, Indiana.

Radiant Heat Assists Quick-Change Act



Cellular-glass blocks minimize heat loss to ground.



External heating coils keep tank contents warm for easy pumping, leave interiors free for easy cleaning.

Labor costs for cleaning the 24 units of Port of Seattle's new vegetable-oil tank farm will be at a bare minimum. This is because the insides of the tanks have been kept free of usual cleaning obstructions—the hot-water heating coils needed for easy pumping of the tanks' often-changed contents.

Instead, heating coils are outside the tanks, mounted on a layer of cellular-glass insulation and embedded in concrete. They radiantly heat the tanks from beneath.

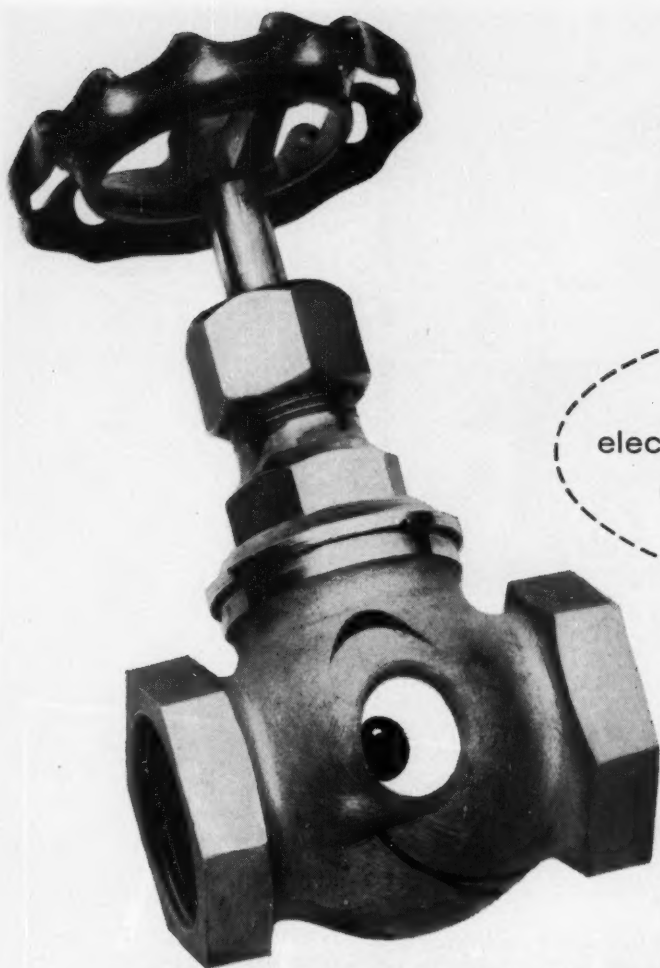
► **Fast Payout**—Cost of the 2.5-million-gal. tank farm was \$300,000.

Only major additional cost for external, rather than internal, coils was for the labor to place the coils more accurately under the conical tank bottoms. Materials costs were almost identical with those of conventional installations; tanks need insulation in any case.

This small extra cost will be fast paid out by recurring labor savings whenever tank insides must be cleaned. Another advantage: The sealed cellular-glass insulation is impervious to moisture—important because of the obvious difficulty of replacing ineffective insulation.

► **How It's Done**—Foamglas insulation was applied over concrete slab foundation, using hot asphalt as adhesive. Roofing felts were mopped in place over the glass blocks, hot-water coils placed in position and covered with a concrete grout. Tanks were then set over the grout surface.

Compressive strength of Foamglas (7 tons/sq. ft.) is high enough to support the weight of the steel tanks and their contents.



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electroless nickel plating
of intricate insides
with ...

PFIZER SODIUM CITRATE

as your sequestering and buffering agent

Complex-shaped interiors, found in many valves and pipes, frequently are beyond the throwing power of an electroplating bath. Such equipment can be successfully plated without electricity by *electroless* nickel plating using Pfizer Sodium Citrate. This ideal buffering agent produces brighter plate in the alkaline bath and as a sequesterant prevents wasteful precipitation of basic nickel salts.

Other Pfizer chemicals of interest to metal finishers include: citric, tartaric, gluconic and oxalic acids, and their salts. Get the full details on how they help you do a superior job of cleaning, polishing and plating.

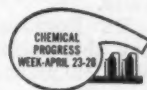
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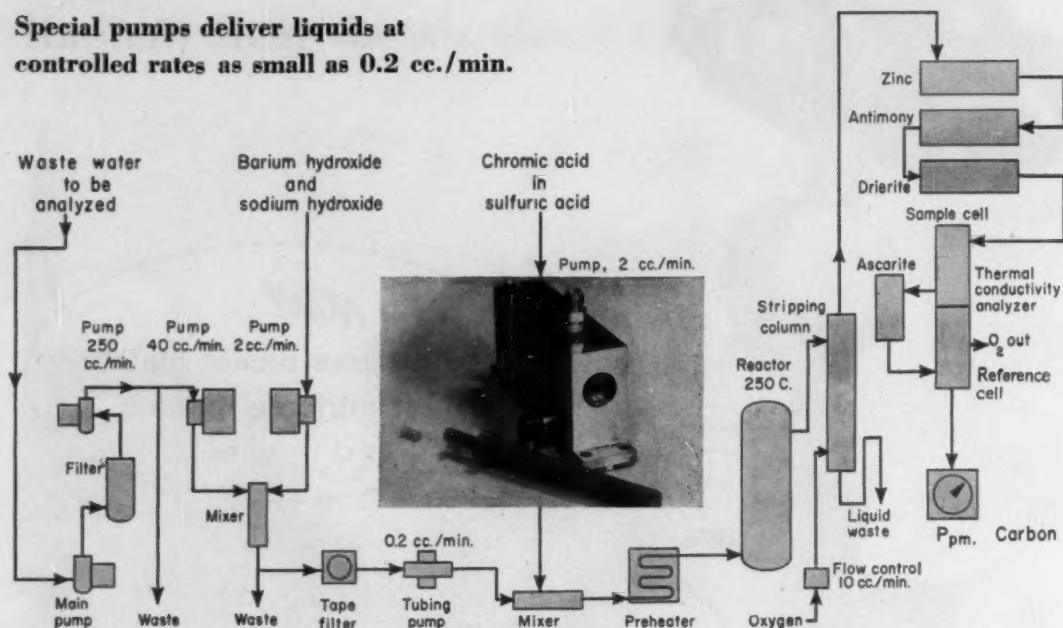


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WHAT'S HAPPENING . . .

Special pumps deliver liquids at controlled rates as small as 0.2 cc./min.



Tiny "Plant" Monitors Process Wastes

Reading directly in ppm. of organic carbon, continuous, automatic analyzer helps Du Pont track down process losses, control content of waste streams.

Process shown in the flow-sheet above involves a dozen or more chemical reactions and unit operations. Yet it operates continuously and automatically, requiring as little as 15 min. per day of attention.

The "plant" in which this process is performed can be put inside a box 3x3x5 ft. It would cost about \$10,000-\$12,000 to build.

Du Pont engineers worked out this miniature automatic chemical plant so they could get a continuous analysis of dissolved organic matter in chemical process wastes. Development costs over the past four years have totalled approximately \$100,000. Right now, company management is mulling over a proposed \$40,000 project which would install two

analyzers on a permanent basis, in their own small building, at Du Pont's huge synthetic organics works at Belle, W. Va.

► **Previous Models**—The organic waste analyzer has already gone through two pilot models.

First of the experimental units was tested at a Du Pont plant near Wilmington. Admittedly crude, this "breadboard" model required full-time attention. But it did demonstrate the fundamental soundness of the analytical method upon which it was based.

Next was a prototype plant model (see cut, p. 122), put in at Belle in September 1954. It took six or eight months to work the "bugs" out of the system, but by the latter part of 1955 this unit was in essentially

full-time service. If present plans go through, this instrument will be replaced by one of the new units; the other new unit will monitor another waste stream.

► **How It Works**—The analyzer determines the organic carbon content of a metered sample stream by oxidizing it to CO₂ with chromic acid. Carbonates and dissolved CO₂ in the sample are removed by precipitation with barium hydroxide prior to oxidation.

Oxidation takes place at about 250 C. and is essentially complete in 2.5 min., the holdup time in the oxidation reactor.

A metered stream of oxygen from a compressed-gas cylinder strips the CO₂ from the still-hot oxidized liquid and carries it to a differential thermal conductivity analyzer. On its way, the gas stream passes through beds of zinc, antimony and Drierite, which remove such interfering components as H₂SO₄, chlorine and water vapor. (Continued)

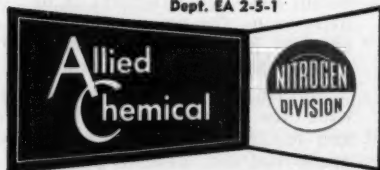


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PROTOTYPE model pointed up need for reliable, small-output pumps.

Carbon dioxide concentration is measured by passing the gas through one conductivity cell, then through a bed of Ascarite for removing the CO_2 , and finally through a second, or reference, cell. The analyzer is calibrated in ppm. of organic carbon in the liquid sample and can detect changes of 1 ppm.

► **Micro-Scale Operation**—Design and construction of a reliable, easily operated, low-maintenance analyzer gets quite difficult as the scale of operation is reduced. But the Du Pont engineers couldn't afford to ignore the cost of the reagent chemicals consumed continuously around the clock.

Costliest reagent is chromic acid. Even at the trickle of 2 cc./min. used in the present model, chromic acid consumption amounts to about \$2,500 worth per year.

Tiniest flow rate, however, is

the waste stream being oxidized. It flows at an almost imperceptible 0.2 cc./min.

► **Novel Pump Design**—Most of last year's problems were due to plugging of small-bore lines and failure of pumps. A lot of engineering effort, perforce, has gone into contriving pumps which would perform reliably at extremely low flow rates.

According to Dick Kieselbach, who virtually lived with these problems for four years—in the field as well as in the Engineering Research Laboratory, Wilmington—development of new micro-scale pump designs has been a valuable by-product of this work. "We have learned what we can't do as well as what we can do," Kieselbach confesses.

One of his pump designs (see out, p. 120) works on the principle of viscous drag. Its rotor is a $\frac{1}{4}$ -in.-diam. Teflon cylinder

with a machined helical channel, 0.007 in. deep, on a pitch of seven threads per in. It fits snugly inside a highly polished cylinder bored in a stainless steel block. When turning at 300 rpm. it delivers 2 cc./min. of chromic acid-sulfuric acid solution. This pump cost about \$300 to make.

► **Other Special Equipment**—In addition to the special pumps, Kieselbach had to design many other components from scratch, such as:

• **Vibrating Mixers**—There are two of these, one for mixing the barium hydroxide solution with the sample stream, another for mixing the chromic acid solution with the sample. Each unit consists of a $\frac{3}{16}$ -in.-bore stainless tube enclosing a $\frac{1}{4}$ -in. stainless rod. The rod vibrates laterally, actuated through a Teflon diaphragm by a 60-cycle coil around a mild steel armature.

• **Carbonate Filter**—This removes precipitated barium carbonate from the sample stream. It consists of a reel of $\frac{1}{4}$ -in.-wide tape of chromatographic filter paper pulled over a port in a smooth stainless steel cylinder at a rate of about 2 in./hr. The sample being filtered floods the underside of the paper, dropping off freely to prevent any possibility of plugs forming. Filtrate is sucked through the paper into the port.

• **Oxidation Reactor**—Electrical preheater, reactor coil and falling-film stripper are combined in a single compact, complex glass unit. Liquids and gases flow inside small glass tubes within a glass jacket; the jacket volume is filled with Santocel insulation.

► **Analyzer Performance**—Function of the analyzer is two-fold—to help control process losses and avoid stream pollution.

Although water pollution is usually measured in terms of five-day biochemical oxygen demand, BOD measurement is of little value for process control because of its poor reproducibility and long time lag.

The Du Pont waste analyzer, with its continuous, reliable and rapid measurement of organic content, should provide

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- is completely compatible with all waxes and actually fortifies all your wax formulations.
- permits close control of coating weight.
- easier to use, easier to handle. You can use higher percentages of A-C POLYETHYLENE on standard coating equipment.

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WHAT'S HAPPENING . . .

plant management with a useful tool for tightening up control of plant operations. The two experimental models have already proven their worth in tracking down unsuspected losses and showing up peak organics concentrations in process wastes.

Detergent Alkylate For U.K. and Canada

A new plant planned for Sarnia, Ont., will give Canada its first domestic source of detergent alkylate (dodecyl benzene) and one newly on stream in Grangemouth, Scotland, erases U.K.'s need for imports of the material.

The \$2.8-million, 10,000-ton/yr. Grangemouth unit was built by Grange Chemicals, jointly owned by British Hydrocarbon Chemicals and Oronite Chemical of San Francisco. The former

supplies the plant's main raw material, propylene tetramer. Only previously existing U.K. dodecyl benzene plant, that of Imperial Chemical Industries, did not meet the nation's total requirements. The new plant provides surplus for export.

The \$38-million Canadian plant will be built by Imperial Oil, Standard Oil (N.J.) subsidiary. When the plant is completed by mid-1957, its output will displace an annual import of about \$2.5 million worth of detergent alkylate.

Esso To Build Two Ethylene Units

Esso Standard Oil Co. is about to start construction on a \$12-million ethylene recovery unit at its Baton Rouge, La., refinery. And at Linden, N. J., late this year, Esso will begin building the

first full commercial ethylene recovery plant scheduled for the East Coast.

Another Alaska Pulp Mill Project Set

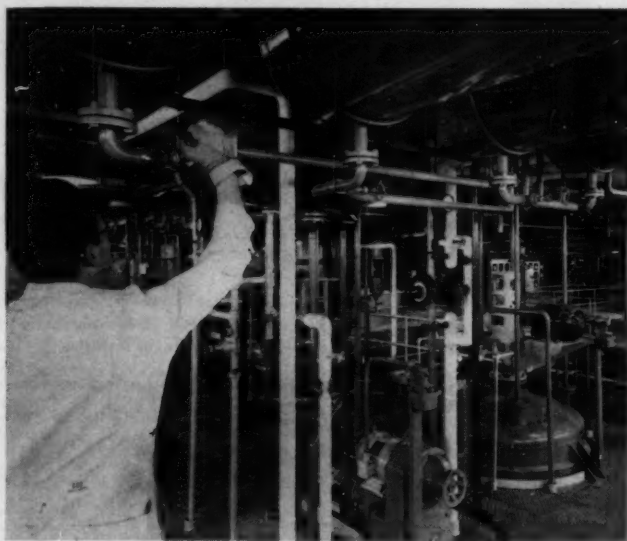
A \$40-million plant to produce a high-alpha dissolving pulp via magnesium-oxide pulping has been set for Sitka, Alaska. The Japanese-financed Alaska Lumber & Pulp Co. will build the plant in exchange for an award from the U. S. Forest Service of 5.25 billion bd. ft. of timber in the Tongass National Forest. Pulp, produced at the rate of 300 tons/day, will be shipped to Japan.

This is the fourth Alaska timber sales agreement involving pulp mill projects, part of a long-range plan to build permanent industry in the North. Ketchikan Pulp Co., which holds cutting rights to about 5 billion bd. ft. in the vicinity of Ketchikan, placed its 100,000-ton/yr. MgO plant in operation in 1954. Pacific Northern Timber Co., Portland, holds rights to 3 billion bd. ft. based on its ability to get an 80-ton/day pulp mill into production at Wrangall by 1962. Georgia Pacific Alaska Co., a wholly owned subsidiary of Georgia Pacific Plywood, was awarded a preliminary contract last summer for 7.5 billion bd. ft. in exchange for a 500-ton/day pulp mill to be built at Juneau.

New Ammonia Plants For South and Northwest

Escambia Bay Chemical Corp. has started up a \$23-million Pensacola, Fla., plant producing 200 tons of anhydrous ammonia daily in addition to other nitrogen compounds. And Phillips Pacific Chemical Co., jointly owned by Phillips Petroleum Co. and Pacific Northwest Pipeline Co., has announced plans to build a \$12-million, 200-tons/day plant near Finley, Wash.

Also in Florida, Escambia Bay plans to put up a 30-million-lb./yr. polyvinyl chloride resin plant. Completion of the plant, which marks the company's entry into the resin business, is expected late this year.



Finishing Step at New Silicones Unit

Maze of pipes and tanks above marks the final production step at Dow Corning's new \$16-million plant for dimethyl silicone fluids and emulsions. Because the new Midland, Mich., facilities double former output, the

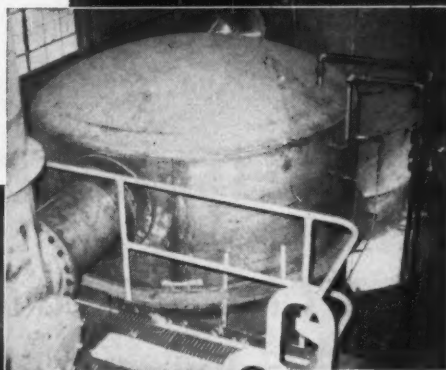
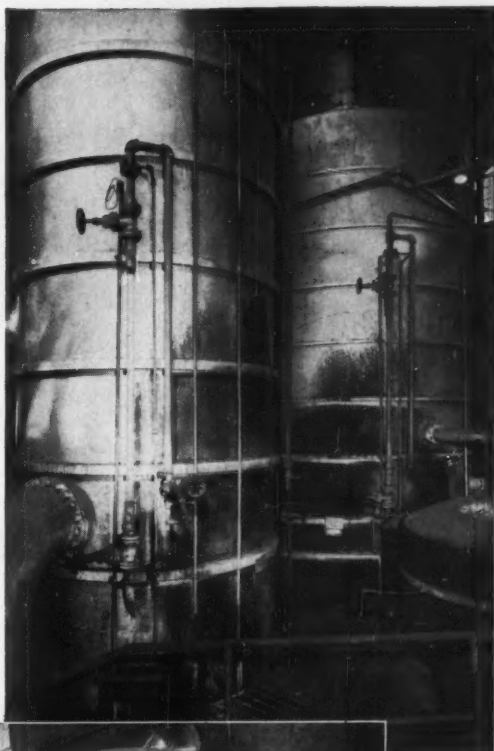
company has reduced prices by 74%. And more silicones production, at a date as yet undetermined, is reflected in General Electric's recent purchase of land adjacent to its Waterford, N. Y., silicones plant.

A **TRIO** FOR PROCESSING PROBLEMS

CONKEY CRYSTALLIZERS, EVAPORATORS AND FILTERS

This is the *trio* that will remedy your crystallizing, evaporating or filtering problems. All three are built to the rugged Conkey design, fabricated in Chicago Bridge & Iron Company's four strategically located shops.

If your plant has a filtering, evaporating or crystallizing problem, write our nearest office. A Conkey engineer will be happy to assist with information, estimates or quotations.



Top: Conkey all nickel construction Triple Effect Evaporator producing 50 per cent caustic liquor.

Above: Conkey Triple Effect Vacuum Crystallizer producing ammonium sulphate.



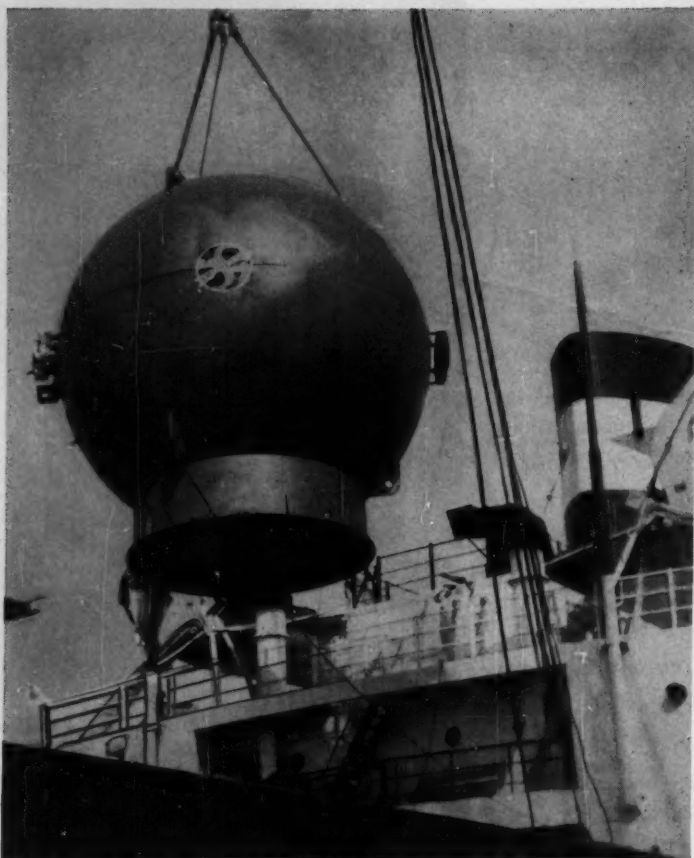
Left: Conkey Rotary Hopper Dewaterer in service dewatering abrasive grains.

CHICAGO BRIDGE & IRON COMPANY

CHICAGO, ILL., HAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

CONKEY
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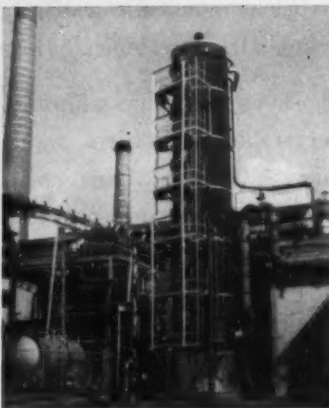
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SPHERICAL DIGESTER (one of six)



BAGASSE SUPPLY



RECOVERY COLUMNS

Furfural Taps New Source

First plant to make furfural from bagasse combines ideal location, guaranteed markets, technical savvy to achieve commercial success.

Currently celebrating its first year of successful commercial operation is Central Romana By-Product Co.'s \$7-million furfural-from-bagasse plant in La Romana, Dominican Republic.

On stream since February 1955, the year-old plant has reason to be proud of this record. It represents the first successful attempt to produce furfural from other than the usual raw materials—corn cobs, oat and rice hulls, bran.

Bulk of Central Romana's 30-

million-lb. annual furfural output has a guaranteed market. Du Pont has contracted to buy an estimated 20 million lb./yr. (for nylon manufacture) for ten years, with an option to take the rest of the plant output and an option to extend the contract.

Other markets earmarked for furfural include the petroleum industry (solvent refining of lube oils) and the resin and plasticizer industries (using furfural and tetrahydrofur-

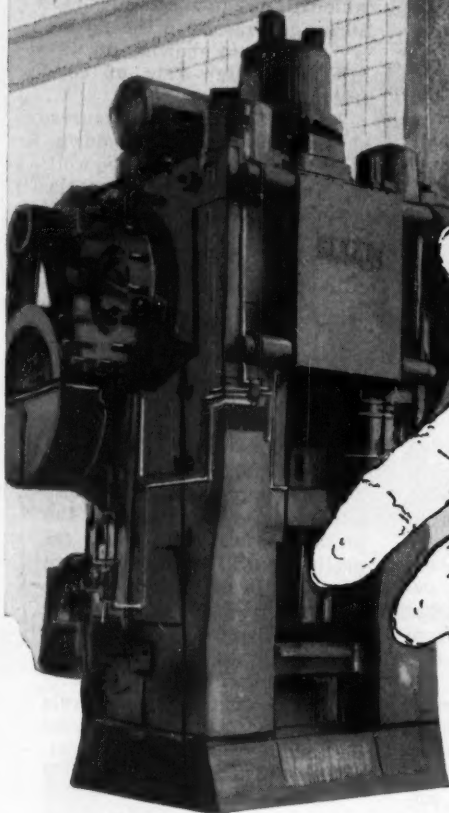
furyl alcohols). Pricewise, Dominican furfural is competitive here with domestic product because it has duty-free status.

► **Mutual Advantage**—Since the economics of furfural production demand large volumes of pentosan-bearing material reasonably close to the producing plant, Central Romana, a subsidiary of South Porto Rico Sugar Co., has an ideal setup. It's backed up against one of South Porto Rico's sugar mills.

And the sugar mill itself benefits from this arrangement. For, independently, sugar mills and furfural plants produce more steam than is required for their individual operations. So by dovetailing the two operations, more efficient use of steam is realized.

► **Pioneer Provides Know-How**—Perhaps the biggest problem Central Romana faced was just

put your lubrication problems in good hands



Centralized Lubricating Systems

First Again

**in design
in performance
in economy**

Remember, it's impossible to under-lubricate or skip a bearing with a TRABON positive system . . . a single indicator at the pump tells the operator when every bearing is properly lubricated.

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Oil and Grease Systems

where to begin. How do you go about setting up a plant for production of an established product, starting with a new raw material?

Quaker Oats Co., pioneer and major U. S. producer of furfural, provided much of the answer. Under a contract with South Porto Rico, QO supplied the technical know-how, with assistance in plant design and construction, plus technical supervision for the "break-in" period.

In return for this service, QO gets a royalty based on the plant's profits for ten years. After the ten-year period is up, QO has an option to buy minority stock interest in the plant.

► **No Pilot Plant**—An interesting sidelight to this project is that it went from small-scale tests directly to full-scale operation, completely bypassing the pilot-plant stage.

Only test work done involved shipping several hundred tons of bagasse to QO's Memphis, Tenn., plant for test cooks. Condensate from these cooks was sent to Vulcan Copper & Supply Co. (Cincinnati), which set up a three-column distillation system to see whether furfural recovery was economically feasible. Once this was established, full-scale design and construction got under way.

Central Romana's process closely follows that of QO—in which corn cobs (23% pentosans, 25% moisture) are hydrolyzed to produce pentoses which, in turn, split out water to form furfural. Residue from the hydrolysis is usually used for fuel.

► **Bagasse Preparation**—Bagasse (12.5% pentosans, 46% moisture), as it comes from the sugar mill is too wet and of too low a density for economic furfural production. Excess water interferes with optimum cooking (dry acid hydrolysis) and renders the digester residue unfit for boiler fuel. Bagasse density, as applied to the large tonnages which must be moved through the plant, would require such a large digester volume that cost would be prohibitive.

Therefore bagasse is densified (baled) and dried by storing

bales in an open field for about two months. Natural fermentation occurring during this storage period supplies the heat necessary to evaporate the excess water.

► **Pressurized Digestion**—With a final water content of about 20-30%, bagasse is fed to a battery of six spherical, rotary digesters—for hydrolysis with relatively small amounts of 5-10% sulfuric acid. (Liquid-solid ratio is about 0.25). The digesters, largest of their type, are 20 ft. in diameter, with ceramic brick lining their 1-in.-thick steel walls.

Under about 50-100 psi. pressure, bagasse is cooked for about 2-8 hr. to produce furfural. Side reactions yield acetic acid, methanol and other organic compounds.

After the digesters are depressurized, coffee-grain-like residue is flash-dried and pulverized, then used for boiler fuel. And exiting reaction-product vapors are carried out by the steam and sent to a recovery system designed to (1) recover heat content of the steam and (2) separate furfural from other low-boiling organics and steam.

► **Recovery System**—High-pressure steam generates low-pressure steam for the recovery system—stripper, distillation and dehydrating columns. Excess steam is sent to the sugar mill for use in evaporators.

Vapors containing 4-6% furfural go to a stripper, where they are azeotropically distilled. Overhead from the stripper (25% furfural) is condensed, then run into a decanter in which two liquid phases separate—the upper, 8-10% furfural; the lower, 90% furfural.

The upper layer is sent to a low-boiling heads column in which aldehydes, ketones, etc., come off as overhead and are discarded. Column bottoms, rich in furfural, are recycled to the stripper.

The bottom, furfural-rich layer from the decanter is dried by stripping off water and methanol in a vacuum (steam-ejector, moderate pressure) dehydrating column. The bottom of the column is kept hot enough

so that no water dilutes the bottom stream of pure furfural.

► **Still Some Kinks**—Because of the nature of the raw material used, Central Romana has experienced at least one problem which it hadn't anticipated: Steam generators in the recovery system are showing an unexpectedly high rate of corrosion.

Though specific causes haven't been pinned down, plant engineers say they're well on their way to licking this vexing problem.

Kaiser to Make More Magnesia Products

Kaiser Chemical Div. will spend \$3 million on additions to its Moss Landing, Calif., seawater magnesia plant and the Columbiana, Ohio, basic refractories plant now being built.

New equipment for the Moss Landing plant will double the present seawater handling capacity and will increase by more than 50% its capacity to produce periclase, which is used in basic refractories for high-temperature furnaces. A large new rotary kiln will have a capacity of about 150 tons of magnesia products per day, bringing total daily kiln capacity to approximately 375 tons.

At Columbiana, plant capacity will be increased by 50%. Completion date for the new construction is set for January 1957.

More Ethylene Oxide Set For Here and Abroad

Wyandotte, Carbide and Carbon Chemicals, Dow Chemical and the French petrochemical giant, Naphtachimie, all have plans for new ethylene oxide production facilities.

Wyandotte has bought a Gulf Coast site for an ethylene oxide-ethylene glycol plant. Carbide is putting in new Seadrift, Tex., facilities for an extra 65 million lb./yr. of glycol, which brings total ethylene oxide capacity to about 200 million tons/yr. Dow is adding 30 million lb./yr. to its ethylene oxide production in Freeport, Tex.

Naphtachimie is doubling the

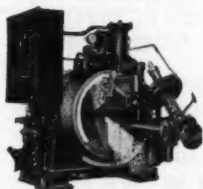
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WHAT'S HAPPENING . . .

8,000-ton/day capacity of its Laverna, France, plant. Like the original plant, built in 1953, the new unit will make ethylene oxide by direct oxidation of ethylene. Plant and process design are by Scientific Design Co., New York. Scientific Design's process will also be used by a plant set up in Antwerp, Belgium,

by Societe Chimique des Derives du Petrole.

In the U. S., Allied Chemical & Dye uses the SD process at its 20-million-lb./yr. unit at Orange, Tex.; it's likely that Wyandotte will do likewise at its proposed Gulf Coast unit. Carbide, too, uses direct oxidation—a self-developed process.



Mobile Unit Rids Water of Radioactivity

Adapted for removal of radioactive contaminants as well as more conventional chores, this new mobile water-purification unit has been developed by Army Engineers.

Standard operations—coagulation, filtration, disinfection—get rid of 85% of the gross fission products. Clay pretreatment ups this figure to 93%, post ion-exchange treatment will boost it to 99.9%.

Available in three sizes capable of handling 3,000, 1,500 or 600 gal./hr. on a 24-hr. basis, the units have already been used by the Army to purify some of the nation's most strategic waters, partially contaminated by industrial and domestic wastes.

Their effectiveness for decontaminating radioactively polluted water is based on the fact that the problem—either

in peacetime or wartime—is basically the same as conventional purification problems. The water itself does not become radioactive—only the dissolved or suspended matter in the water.

► **Pollution Sources**—Principal sources of radioactive pollution—all of which can be counteracted by these new units—are: Waste effluents from atomic energy plants; waste discharges from laboratories and hospitals using radioisotopes; fall-out of fission products, in case of an atomic explosion; induced activity in the dissolved mineral matter in the water after an explosion; blow-in or wash-in of radioactive dust or soil after an explosion; fall-out of undissociated uranium or plutonium after an explosion.

Heart of the units is an "erdlator" (named for Engineer Research and Development Laboratories), which chemically coagulates and removes mud, bacteria and other suspended matter in the water and makes effective disinfection possible. This device is connected in series with diatomite filters. The combination not only removes silt and destroys bacteria, but also provides positive physical barriers to the passage of organisms which cause water-borne diseases.

► **Fast, Simple Operation**—Polluted water can be pumped into the unit, chemically and physically treated and discharged as potable water in about 20 minutes. Short detention times are credited to the use of pulverized limestone, which is almost universally available and costs less than \$12 per ton.

Only one man is needed to attend a unit; it can be put into operation by three men in less than 90 minutes after arrival at a site, will work in atmospheric temperatures as low as -40 F.

In transit, the unit consists of an insulated van body, mounted on a 2½-ton truck chassis, which in turn tows a single-axle 1½-ton trailer. It has its own electrical power supply, heating facilities and initial expendable operating supplies.



Look into "United" lead-lined products

to keep corrosion

in line

... get them from

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Company***

Under the trade name "United," National Lead Company manufactures lead-lined pipe in two categories... "United Tubond" and "United" expanded. Both combine the corrosion resistance of lead with the strength of steel.

"United Tubond" pipe is used where acid handling is difficult, where the lines are subject to external abuse, vibration, high internal pressure, elevated temperature or vacuum. In "Tubond" pipe the bond between lead lining and steel pipe is virtually inseparable.

"United" expanded lead pipe, generally used for handling acids under "average" conditions, is produced by inserting a lead pipe in a steel pipe and expanding the lead lining under heavy pressure.

Whether you buy "United Tubond" or expanded, you may be sure you are getting a product with the

grade of lead, thickness of lining, and method of joining calculated to give you your money's worth in strength and corrosion resistance.

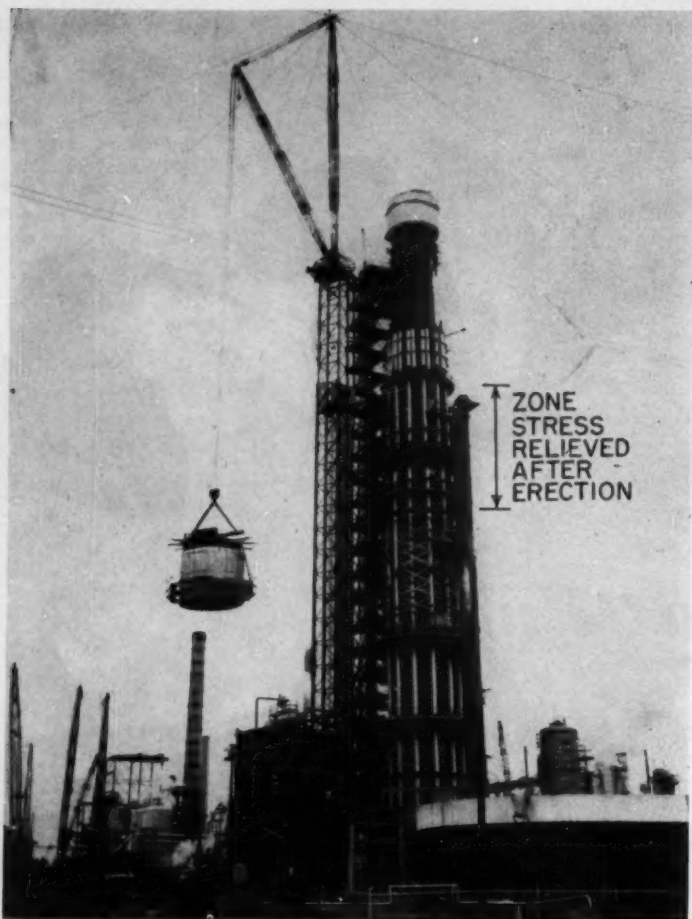
Under the "United" brand you can also get the other components of a corrosion-resistant acid handling system — valves, fittings and pumps.

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HOUDRIFLOW reactor, containing maze of internal parts, was . . .

Stress-Relieved 200 Ft. Up

Unusual requirements for heat-treating 25-ft.-dia. by 71-ft.-high tower section after erection called for novel technique, with the vessel serving as its own oven.

Sidewalk superintendents at Sun Oil Co.'s Marcus Hook (Pa.) and Toledo refineries may still be nursing the cricks they got in their necks while watching Chicago Bridge & Iron experts stress-relieve the reactor portions of identical Houdriflow cracking units recently installed at each location. The reason: CB&I did the job after the reactors were in place, 200 ft. above the ground.

This "oven-in-the-sky" technique was unusual, but so were the requirements of the job. The 25-ft.-dia. by 71-ft. reactors each carried a maze of internal piping, baffles, fittings and special structures. They were made of chrome-moly steel clad with Type 410 stainless in thicknesses varying from 5/8 to 2 1/2 in. Each assembly weighed 250 tons.

To ship to the site and erect

a heat-treating furnace large enough to handle these huge units, if assembled and stress-relieved on the ground, would have been a Herculean task. Yet the alternative—to heat-treat 200 ft. in the air—seems more practical only after a look at the method as successfully used.

► **How They Did It**—For each reactor about 20 tons of temporary heating equipment, capable of liberating 24 million Btu./hr., was mounted 164 ft. above ground level on the stair tower of the cat cracker. Two-inch piping carried refinery gas at 30 psig. up the stair to a regulator. From here it was distributed through 8-in. lines to four burners in a special 9x12x24-ft. box-type combustion chamber.

Inside the reactor itself, at the lower limit of the zone to be heat-treated, a temporary steel bulkhead was laid. Externally, the sides of the shell and the top head were insulated with temporary layers of magnesite and mineral wool block to an average thickness of about 4 in. All of the many openings (more than a dozen were 6 in. dia. or larger) were covered, except those few selected for vents and flues. Mineral wool insulation was laid on the temporary bulkhead bottom.

A 50,000-cfm. blower (requiring a 100-hp. motor) pumped the 1,400-F. gases from the combustion chamber through a 58-in.-dia. side manhole into the reactor shell at about 1 oz. pressure.

► **Needed: The Master's Touch**—Advance provisions for heat distribution—a particularly delicate part of the CB&I technique—kept the temperature variations between any two points in the huge, complicated structure well within bounds.

ASME code for unfired pressure vessels permits up to 150 F. variation. Actual variation was less than 90° at the start of the 4-hr. holding period, less than 40° at its end. (Total cycle was 30 hr.—12 hr. to heat up, 4 hr. at stress-relieving temperature of about 1,200 F., 14 hr. of controlled cooling.)

Here's how CB&I engineers achieved such precise control:

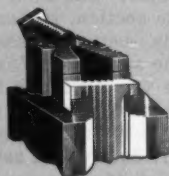
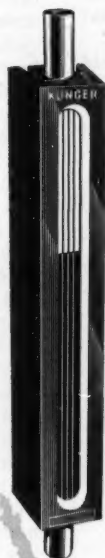
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YOUR PLANT

KLINGER REFLEX LEVEL GAGES

The "K" Type Reflex Level Gage has the following outstanding advantages:-

- Single row of tightening bolts.
- Body free from distortion.
- Glass easily removed.
- Gage body turnable, free to expand, and easily removed.



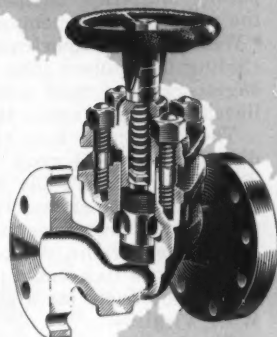
Write to your Klinger agent for descriptive leaflets and literature.

INSTALL KLINGER FITTINGS

SEATLESS PISTON VALVES

The Klinger Valve consists basically of a finely ground piston, operated by the valve spindle and hand wheel, and moving through two or three non-metallic resilient valve rings, capable of resisting steam, oil and most fluids at high temperatures and pressures, and separated by a ported lantern bush. It has the following advantages:

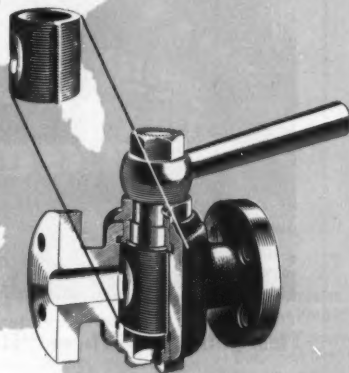
- No seat—consequently no regrinding.
- Can be serviced in the line.
- Unaffected by wiredrawing.
- Unaffected by throttled use.



SLEEVE-PACKED COCKS

In the last quarter of a century Klinger Sleeve-Packed Cocks have steadily replaced the old-fashioned asbestos-packed cocks with their limitations of working pressure, difficulty of repacking and tendency to jam. They are available in a wide range of designs and sizes for all purposes and pressures, and with the following advantages:

- Renewable "Klingerit" packing sleeve.
- No-tightening during use.
- Parallel-ground non-jam plug.
- Unobstructed straight-through full-bore passage.



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RE/36/27

WHAT'S HAPPENING . . .

- They put in some 30 thermocouples, distributed over and within the shell at critical points to check temperatures.

- A baffle plate inside the vessel directed the hot gases through the disengager head to the very bottom of the section being treated.

- They manipulated the heat distribution by adjusting temporary butterfly dampers on the selected vent openings.

► **Wealth of Experience**—Including the Sunoco jobs, CB&I engineers have field stress-relieved about 67 vessels to date.

They've done a host of pulp digesters, have 24 more on the docket for the Pacific Northwest this year alone. They've done petroleum refinery vessels and coke drums, creosoting cylinders, an Oak Ridge job for AEC, alloy ducts for a plant in West Virginia.

They've also used the method to forestall "caustic corrosion." This is a condition where am-

monium nitrate and other solutions preferentially attack along stressed lines in vessels and eat right through, even causing cracks.

► **Why After Installation?**—All these cases present some combination of the factors which make post-installation stress relief—difficult and expensive though it is—about the only efficient choice. For example:

- The vessel is too massive, like the Sun Oil reactors. In overland shipping, for example, about the biggest vessels that can go intact are 13 ft. dia.

- Thousands of feet of weld have to be heat-treated with the body because service temperatures will be high (external insulation rather than internal), like the Sun Oil case.

- Final position of the vessel—perhaps at a great height, inside a maze of structural steel or in between preceding and succeeding units in a process sequence—makes installa-

tion after assembly awkward.

- Salvage and re-use value of materials and equipment involved can cut costs greatly.

- Know-how on heat generation and distribution can do likewise.

► **A Norm Evolves**—In most of CB&I's field stress-relief jobs, the vessel itself is used as an oven. A specially designed burner, which can throw a 100-ft.-long flame, is directed inside the vessel, and a series of thermocouples and recording instruments control heat.

An average treatment would be a heating cycle of 8-10 hr., holding to temperature for 1-2 hr., cooling cycle of 8-10 hr. ASME code requires 1,100 F. for an hour for each inch of thickness.

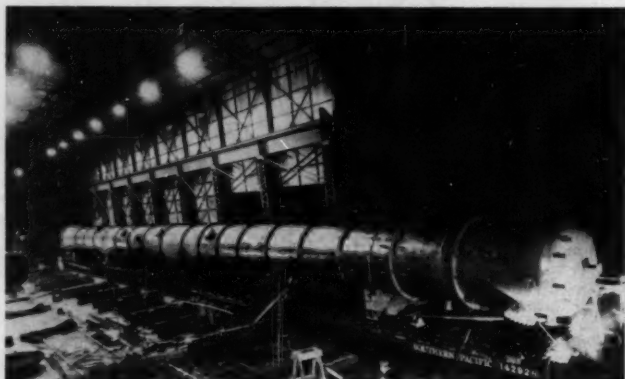
► **A Variation**—The regenerator portion of the Sun Oil units, located beneath the reactors already described, called for different handling.

Instead of using the vessel itself as oven, CB&I used a 34-ft.-dia. x 24-ft.-high oven sitting on the ground to treat each of ten sections of the regenerator. This was most practical here because: The alloy pipes within the section, rather than the welds between sections, needed the stress relief; a 100-ton crane was available to lift the finished pieces into place; the expense of insulating each piece individually was saved.

Total cost of stress-relieving each Houdriflow unit was about \$100,000, somewhat higher than average due to the job's novel aspects. For an 80-ft.-high x 20-ft.-dia. coke drum, where the customer furnishes the insulation, post-installation stress relief can be done for about \$10,000 to \$30,000.

► **Lower Costs in Sight**—In all these jobs, the big expense is insulation and attendant labor; cost of fuel, labor incident to stress-relieving, etc., are negligible. Insulation, including labor, costs about \$2 per sq. ft. Only about 40¢ of this is for insulation material.

CB&I is about to try out a new insulation system, using a thin spray. The company hopes to get costs, including labor, down to about 50¢ per sq. ft.



This Job Took Three "Heats" on the Ground

Though this fractionating tower for American Cyanamid's new monomethyl styrene plant at Avondale, La., is a dizzy 186 ft. tall, economics of installation favored stress-relieving beforehand (see story above). Within the 13-ft.-dia. shipping limit by 5 ft., the tower—fabricated by Delta Tank Mfg. Co. (Baton Rouge, La.) in two sections—proved easier to weld, stress relieve, then transport and erect in a single, completed piece.

Stress-relieving took place in three "heats" in Delta Tank's new 75-ft. jet-fired furnace, which resembles a shoe box without ends. First third of the tower moved into place aboard the flat cars on which it was built, and the ends of the furnace were bricked up around it. After treatment at 1,300 F., the fire-brick walls were knocked out, the next section moved into the chamber and the brick walls rebuilt to prevent heat loss.

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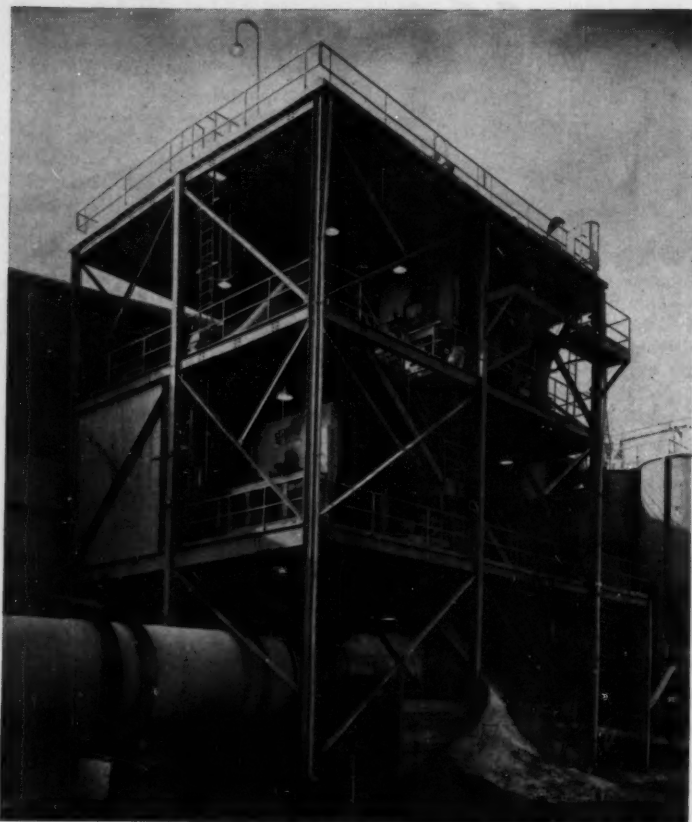
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MIXER, pelletizer, dryer (top to bottom) turn out a . . .

Product Mix Keyed to Demand

New Los Angeles mixed fertilizer plant majors on simpler, lower-analysis granulated products in line with demands of specialized Western markets.

Joining one industry trend—and resisting another—is Stauffer Chemical Co.'s new \$900,000 mixed-fertilizer plant at Los Angeles.

Stauffer has lined up with the current move towards pelletized fertilizers. With rangeland fertilization becoming more and more a large-scale reality in California, pelletized fertilizers should get a big boost.

And since pelletizing requires rather substantial capital—out of the economic range for the average small mixing-plant op-

erator—Stauffer joins other large companies which are converting or expanding to handle the demand. First truckload of product left the new plant in January.

► **Bucking the Trend**—Despite another trend toward complete mixed and high-analysis fertilizers, there is still a sizable Western market for normal superphosphate. With this in mind, Stauffer based its plant and process on production of pelletized super.

Initial products are normal

superphosphate, 5-15-0, 10-10-5, 10-10-10 and 17-7-0. Insofar as possible, changes will be made to accommodate demands, but with a plant capable of turning out 30-40 tons/hr. it's not economical to make small lots of many different formulations.

► **Here's Why**—Stauffer feels that there are two particular advantages to its low- and medium-analysis products, especially in the West.

For one thing, calcium sulfate, the "inert" ingredient that lowers the N-P-K analysis, is actually in big demand in California (where more than 600,000 tons of gypsum is applied to the soil each year). Its presence in fertilizer (up to 54% in normal superphosphate) can be a distinct market advantage, permitting the farmer to apply a significant portion of his sulfur requirements in one pass with his fertilizer.

In the second place, lower-analysis products permit more even distribution, are considered more economical where light dosages are sufficient. This is especially true for rangeland fertilization.

► **Engineering Features**—Although Stauffer's mixing process is conventional, it boasts several features which appeal to chemical engineers:

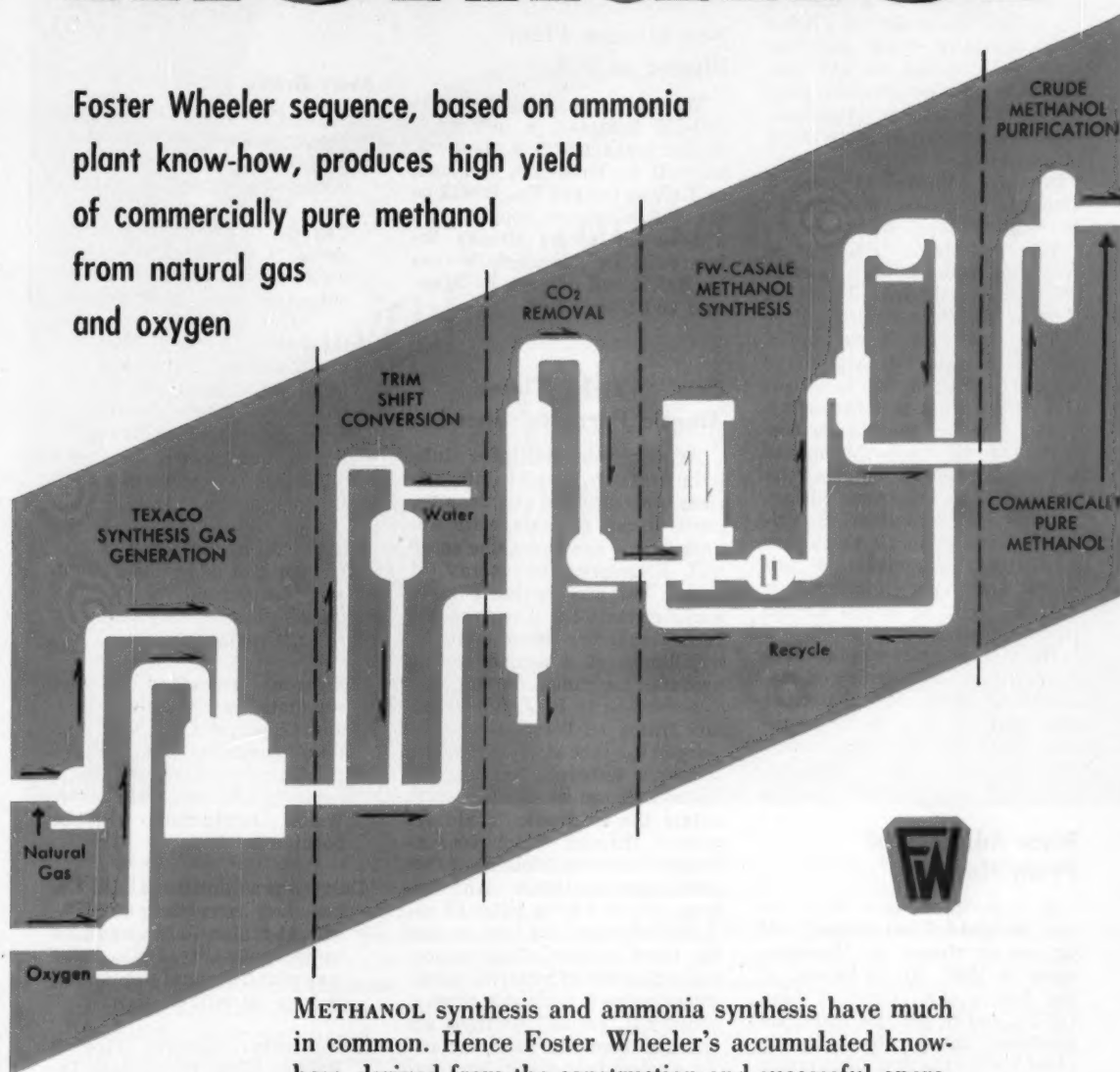
- An ammonia scrubber and a special plate-and-wire electrostatic precipitator of Stauffer's own design enable the plant to meet Los Angeles Air Pollution Control District's stringent regulations. The precipitator is the first one to meet APCD specifications for fertilizer plants. Recovered fines are returned to the process.

- The plant uses automatic batching. Solid raw materials (superphosphate, potash, special additives) are stored in five hoppers, which feed a moving belt. Interlocking, foolproof electronic controls monitor the hoppers, which can be set to deliver 25-350 lb. per dump to the belt at a rate of two to four dumps per min. Any over- or underweight dump from any hopper immediately "freezes" the entire mixing operation until the situation is corrected.

- A specially constructed

methanol

Foster Wheeler sequence, based on ammonia plant know-how, produces high yield of commercially pure methanol from natural gas and oxygen



METHANOL synthesis and ammonia synthesis have much in common. Hence Foster Wheeler's accumulated know-how, derived from the construction and successful operation of six large ammonia plants, is of great value in the planning and construction of modern methanol units. The FW sequence for production of commercially pure methanol is shown above.

For further details on this FW sequence, write to *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

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WHAT'S HAPPENING . . .

continuous ammoniator just ahead of the mixing drum provides for reaction of anhydrous ammonia with either sulfuric or phosphoric acid or a mixture of the two. It consists of a 5-ft.-long specially lined stainless steel tube, tilted at 45° and baffled to provide complete mixing of the reactants. Ammonia enters the tube directly, acid tangentially.

► **Process Wrap-Up** — Small amounts of water are added to the mixing drum as needed to aid in pelletizing. Exothermic reactions in the mixer help flash off excess moisture. Retention time is less than 1 min.

The material goes to a second, identical rotary mixer which completes the pelletization. Product passes through a dryer, a cooler, then to packaging. Since aged superphosphate is used as starting material, the final products require no curing.

When desired, sulfur, insecticides, trace minerals and other agricultural chemicals or soil conditioners (particularly ferric sulfate) will be added at the proper processing steps.

Special attention to plant layout, automatic controls and mechanical materials handling has paid off; the entire operation takes less than 0.1 man-hr. per ton.

More Adipic Acid From Monsanto

A new adipic acid plant, to cost several million dollars, will be put on stream by Monsanto early in 1957. To be located at the Luling, La., plant of Lion Oil Co. and to use raw materials produced there, the proposed plant marks the first integration of facilities since the Monsanto-Lion merger last fall.

Hercules To Boost PE Capacity

Construction has started on a \$6-million, 24-million-lb./yr. pentaerythritol plant for Hercules Powder Co. To be located at the Louisiana, Mo., site of the company's ammonia works, the new plant is scheduled to begin operations early in 1957. It will

also produce 100 million lb./yr. of formaldehyde, basic raw material for PE.

New Oxygen Plant Biggest in U.K.

To start up early next year at 250-300 tons/day, a new \$1.4-million tonnage oxygen plant will be built in Yorkshire, England, by British Oxygen Co. It will be the U.K.'s largest, topping two 200-ton/day plants already being built in Lincolnshire—one by B.O.C. and another by Stewarts and Lloyds Ltd.

New "Watch" Times Atomic Particles' Speed

A new photomultiplier tube promises new insight into nuclear structure and reactions because it can measure, with unprecedented exactness, the speed and, therefore, the energy of atomic particles taking part in nuclear reactions. The tube has been laboratory-timed down to a billionth of a second and is probably ten times faster.

According to E. J. Sternglass and Milton M. Wachtel, who developed the tube at Westinghouse Research Laboratories, its precision is based on a new way to obtain the electronic "chain reaction" through which conventional photomultiplier tubes strengthen radiation. An electron, released by a pulse of radiation entering the tube, strikes the front surface of an exceedingly thin film of material chemically similar to table salt. Several additional "bonus" electrons are knocked from its back surface. An electric field speeds up these new electrons and aims them at a second film, where each one releases more electrons from that film. This increase of electrons continues through several steps. In this way the tube gets its multiplying effect.

But in conventional photomultiplier tubes, thick metal plates, instead of thin salt films, are used to obtain the bonus electrons. Electrons must be guided through a number of complicated paths in going through the tube. In the Westinghouse tube, the

electrons always move straight ahead. This shortens their paths and travel time through the tube, prevents straggling from stage to stage.

News Briefs

Pulp: B. C. Forest Products Ltd. has increased its originally planned investment of \$25 million to establish a pulp mill at Vancouver Island, Canada, to \$36 million. Daily capacity of bleached sulfate pulp becomes 425 tons. Entire output goes to Scott Paper.

Adhesives: Chemical Process Co., Redwood, Calif., has entered the adhesives business; will make conventional protein glues under Monsanto license and phenol and urea adhesives by a new process of its own design.

Plastics: Borg Warner Corp. will build a \$10-million plant at Washington, W. Va., for its high-impact thermoplastic resin, Cycolac.

Hydrogen peroxide: Almost completed is Food Machinery and Chemical Corp.'s \$1-million expansion of its Becco electrolytic hydrogen peroxide plant at Vancouver, Wash. Production will be boosted by 50%.

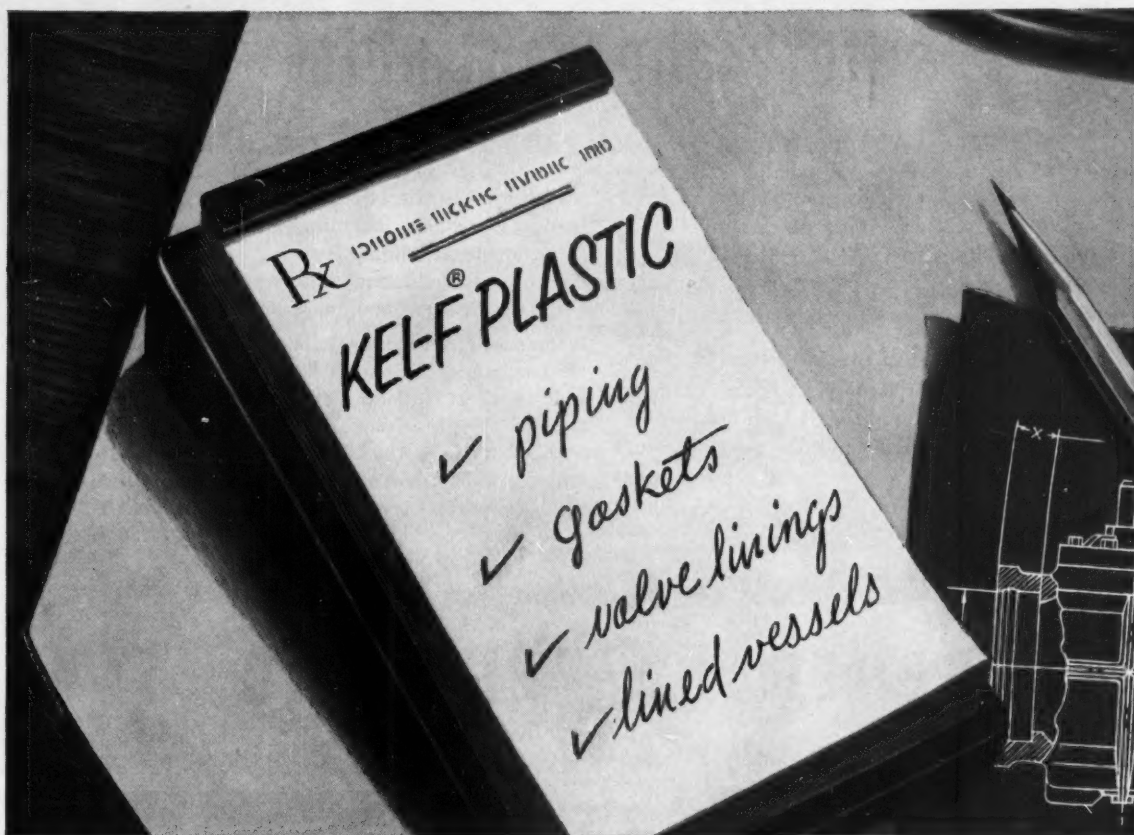
Dairy wax: Continental Oil Co. has just completed a \$450,000, 11-million-lb./yr. addition to its Ponca City, Okla., dairy wax plant. Annual production is now 20 million lb.

PVC resin: General Tire & Rubber plans to increase facilities at its new \$6-million polyvinyl chloride resin plant at Ashtabula, Ohio, by 50%.

Titanium: Metal & Thermit Corp. has started building a \$750,000 plant for mining and processing of titanium-bearing ore near Montpelier, Va. In England, Laport Titanium, Ltd. is increasing capacity of its Lincolnshire titanium dioxide plant from 18,000 to 30,000 tons/yr.

CURE FOR

PRODUCT CONTAMINATION EQUIPMENT CORROSION



ONE OF THE HAZARDS of equipment corrosion is the resulting contamination of the product being processed. In such critical cases KEL-F fluorocarbon plastic offers a practical solution by providing a barrier between corrosive process stream and processing equipment.

Molded and fabricated valve linings, gaskets, ring seals, piping, and tubing of KEL-F plastic and laminated lined tanks, vessels, and reactors protect equipment against corrosion . . . prevent product contamination.

A UNIQUE PLASTIC

KEL-F plastic is virtually inert to all chemical attack—including mineral acids, oxidizing agents, and strong caustics. Its anti-adhesive property is an advantage in maintaining clean, unclogged lines and equipment.

A dense, tough thermoplastic, KEL-F plastic has outstanding physical properties: high compression strength, resistance to heat and cold, low moisture absorption. Supplied as a molding material, it can be readily molded by injection, transfer, or extrusion. Qualified fabricators are now producing pip-

ing and fittings, tubing, sheets, plastic laminates, rods and film of KEL-F plastic.

KEL-F Plastic Dispersions Available

Kellogg also supplies KEL-F plastic dispersions for coating equipment where size or construction makes molded plastic impractical. The resultant coating is tough and adherent—with all the outstanding properties of the molded plastic. If you do not maintain a coating department, we can put you in touch with experienced applicators.

Why not take up your specific corrosion problem with one of our chemical engineers. He'll show you how KEL-F Plastic or KEL-F Dispersions may be just the solution. Write us today.

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SUBSIDIARY OF PULLMAN INCORPORATED



Chemical Manufacturing Division
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General Electric EM* Pumps . . .

Move liquid metals with greater safety and continuity

... OPERATE WITHOUT MOVING PARTS, SEALS, OR BEARINGS

General Electric electromagnetic pumps, first designed for radioactive and high-temperature systems, are now used in liquid metal laboratories and industrial processes where minimum leakage and continuous operation are important.

Now designed to pump liquid metals at temperatures up to 1500 degrees F and to move up to 10,000 gallons per minute with accurate control of flow, General Electric EM pumps can be used to move such metals as sodium, sodium potassium, lead, bismuth or mercury.

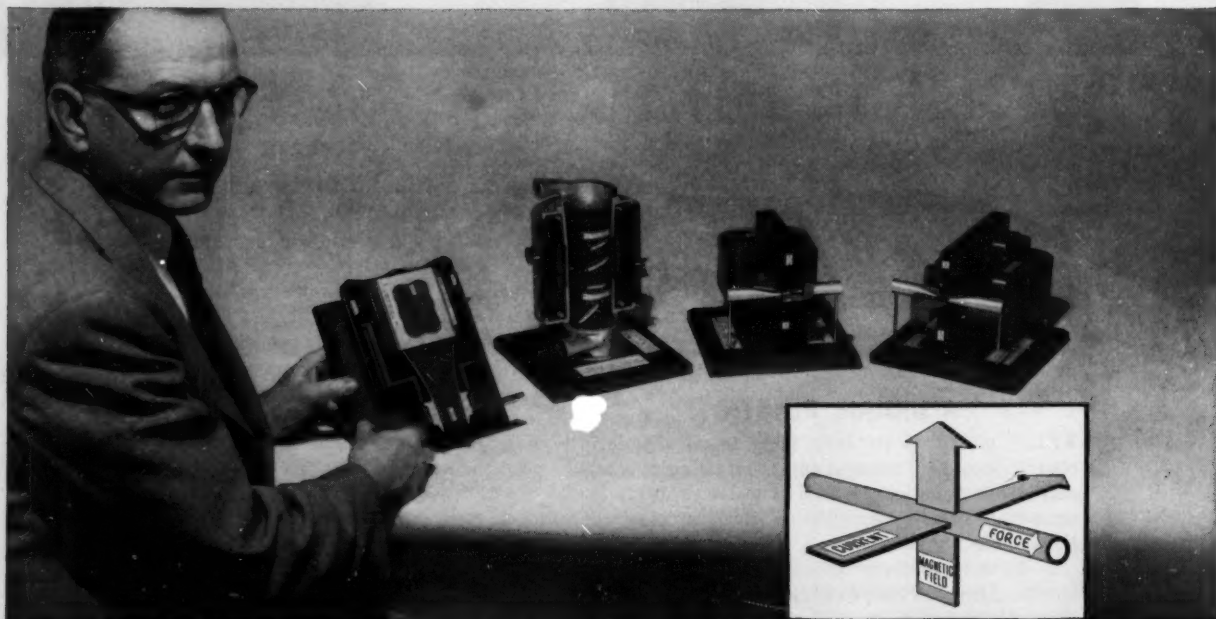
*Electromagnetic

General Electric offers complete liquid metals pumping systems including EM pumps, magnetic flowmeters, liquid level indicators, pressure transmitters, induction heaters, cold traps, plugging indicators and sodium oxide control stations.

For more information on liquid metals pumping systems and components, contact your nearest G-E Apparatus Sales Office, or Section 193-1, General Electric Company, Schenectady 5, New York. Outside of the U.S. and Canada write to: International General Electric Company, Inc., 570 Lexington Avenue, New York City, N. Y.

Progress Is Our Most Important Product

GENERAL  ELECTRIC



FOUR GENERAL ELECTRIC EM PUMP MODELS are shown by J. F. Coge, Manager—Component and Coolant Systems Engineering Operation, Atomic Power Equipment Department, (l. to r.):

linear induction, helical flow, d-c, and a-c types. Diagram shows pumps' operating principle: Force is exerted on current-carrying liquid in magnetic field.



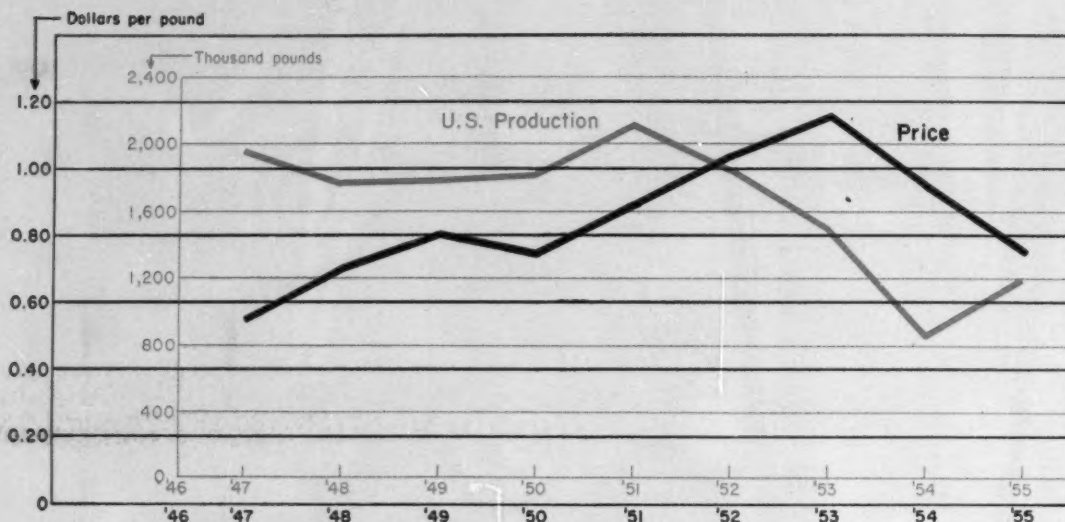
LIQUID METAL LOOP tests sodium potassium (NaK) in a G-E electromagnetic pumping system for use as heat-transfer agent. Loop's a-c EM pump (below) operates at 600 degrees F with capacity of 30 gallons per minute. Magnetic flowmeter (left of pump) measures flow externally, providing greater safety.



GENERAL  ELECTRIC

Chemicals & Raw Materials

EDITED BY R. K. GITLIN



Pyridine: Back From the Doldrums

Now that pyridine is well on its way to licking the problems of tight supply and skyrocketing prices, it faces another problem—developing new markets.

Remember the gloomy pyridine outlook just two years ago—the production slump and high prices? Well, the picture has brightened. The gap between supply and demand has narrowed and pyridine is once again ready to do the jobs it's best known for—as a solvent, acid acceptor, chemical intermediate and yield booster.

To get an idea of just how pyridine has made its comeback, let's take a look at some of the problems it's had to face.

► **Price Zooms, Then Tumbles**—Coming as it does in such minute quantities (one ounce per ton of coal) from coking operations, pyridine has always been an "elite" chemical—relatively high priced.

From 45¢/lb. in 1938 (first year of domestic commercial production), it rose to \$1.15 in 1953—then tumbled to 95¢ in

1954 and 75¢ in 1955. The scramble for substitutes caused by skyrocketing prices was responsible for the 1954 decline. And 1954 and 1955 price reductions no doubt have given much of the impetus to its recovery in the past year.

► **Production Slump**—All of the seven producers* of refined pyridine were seriously hit by the 1954 slump, when producers of niacin, which had consumed almost 40% of the pyridine production, changed to a cheaper, synthetic raw material (2-methyl, 5-ethyl pyridine).

Pyridine inventories mounted dangerously in the face of declining sales. Consumer inventory liquidation and erratic foreign prices aggravated the problem.

* Pittsburgh Coke & Chemical, U. S. Steel, Barrett Division of Allied Chem & Dye, Reilly Tar & Chemical, Koppers, Donner Hanna.

► **Major Roadblocks**—Market studies showed two major obstacles to growth: limited availability, relatively high cost.

Despite the greatly reduced demand potentially limited availability was still a problem. Consumers remembered the quantities they had to import during the Korean emergency at prices up to two dollars per pound. There was a natural hesitancy to use pyridine in new products and processes in the face of a limited supply.

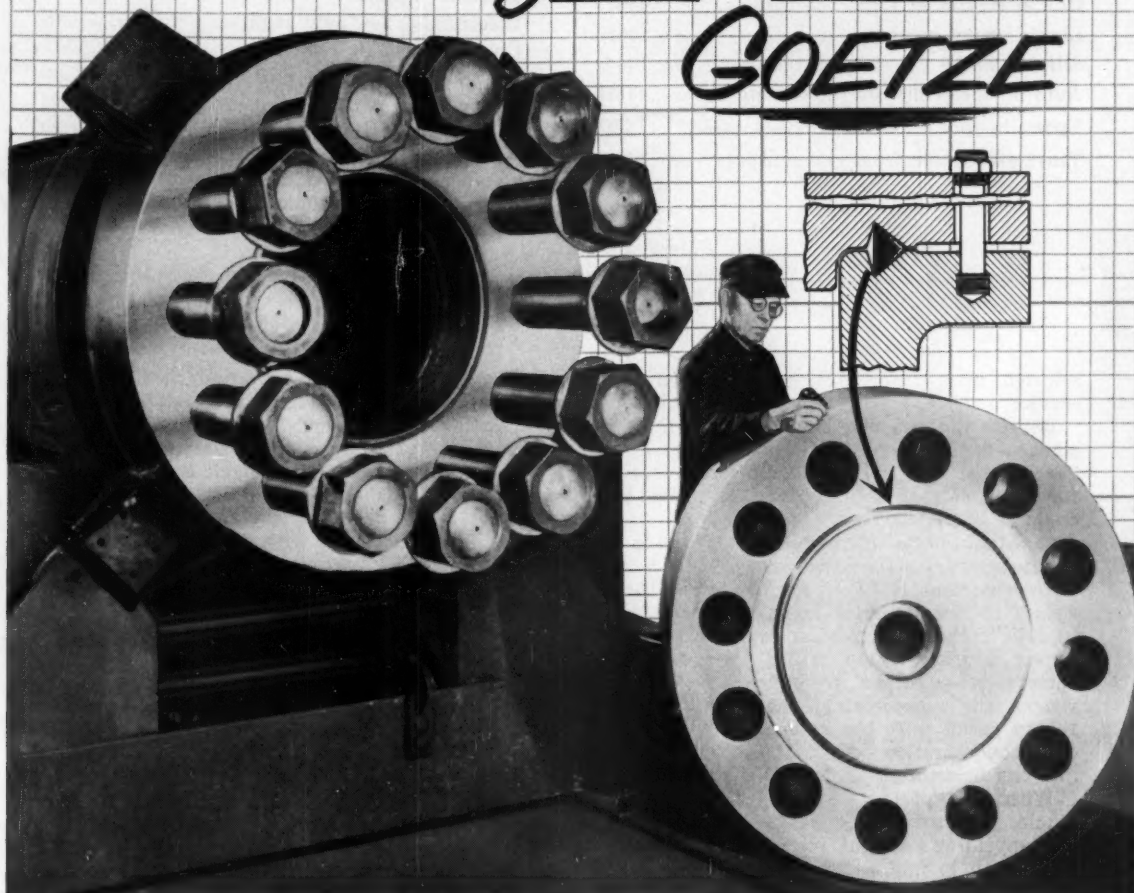
Actually the potential supply of pyridine from U.S. coke ovens is better than 5 million pounds, far over the 2.2 million pounds consumed in 1951 and 1952. But the fear still existed that this potential might not be reached because of difficulties in encouraging coke oven operators to put in the equipment necessary for such a small volume product.

► **On The Right Track**—Worries on this score were removed, to a great extent, when Reilly Tar & Chemical announced its synthetic pyridine process and Pittsburgh Coke & Chemical in-

PRESSURE: 15,000 PSI

TEMPERATURE: 450 F

GASKET: *Johns-Manville*
GOETZE



**How A. O. Smith maintains
tight seals in giant
"Multi-Layer" vessels**

Today's tremendous pressures and temperatures have placed special demands on manufacturers of processing equipment. A. O. Smith has answered this need with a special type of "Multi-Layer" vessel construction. And Johns-Manville in turn has provided gaskets that assure tight seals under these exacting conditions. Typical of these is the delta type gasket,

illustrated above, which was designed, for this application, to withstand pressures up to 15,000 psi. and temperatures to 500 F.

The development of special gaskets to meet special purposes has been the stock in trade of Johns-Manville's Goetze division for more than sixty-five years. Expert technicians possess a knowledge of metals and other factors related to gasket design and performance that is unmatched in the field. What's more, intensive specialization and modern production tooling

provide substantial cost savings on J-M gaskets.

If you need gaskets for high pressure vessels for similar applications, send us a drawing or template for quotation. If you have a sealing problem of any kind, J-M technicians will work directly with your own engineers to develop new gaskets—or adapt existing styles—to meet your specific requirements. Write for further information to Johns-Manville, Box 60, New York 16, N. Y. In Canada, Port Credit (Toronto), Ontario.



Johns-Manville PACKINGS & GASKETS

Newsworthy chemicals this month

Pyridine on the comeback trail.....	142A	Apple fungicide controls rust.....	148E
Oil-well corrosion inhibitor.....	144A	Aluminum-silicone paint	150A
Scale preventive	146A	Automotive chemicals	150B
High-strength poly resin.....	146B	Low-volatility plasticizer	150C
Quilon treatment improves leather.....	146C	Miticide	150D
Liquid epoxy hardeners.....	146D	Electrical-grade poly resins.....	150E
Silicone finish for glass cloth.....	148A	Chromatographic reagent	150F
Auto finishes cut need for waxing.....	148B	Oil-resistant surface coating.....	150G
Epoxy insulation weatherproofs cable....	148C	Epoxy-based potting compound.....	150H
Vinyl propionate from two sources.....	148D	Semifluid synthetic grease.....	150I
		Additive increases lube efficiency.....	150J

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stituted its pyridine recovery service.

Despite the two major price slashes of 1953 and 1954, the 75¢/lb. cost was still too high for many solvent uses. Prices couldn't be reduced much further without curtailing supplies of crude pyridine from the coke oven operations. But Pittsburgh Coke's recovery service helped to relieve the cost problem by giving a price rebate to consumers who return pyridine wastes for reprocessing. The rebate varies with the amount and concentration of wastes and can be as high as 60%.

With most of the major obstacles to growth out of the way, pyridine's unique properties began to find wider application in fields where it had already made a name for itself—pharmaceuticals, photographic chemicals, textile waterproofing, rubber accelerators and germicidal surface active agents.

► **Unique Solvent, Acid Acceptor**—As a solvent, pyridine is completely miscible with water and almost all organic solvents. Organic compounds can be purified or recrystallized by dissolving in pyridine, then carefully diluting with water or, in some cases, other solvents.

Though a tertiary base, pyridine has a pH of 8 to 9.5. Therefore it's particularly valuable in reactions whose products are

vulnerable to hydrolysis or chemical change under acid or alkaline conditions. And its stability limits the probability of side reactions and reduced product yields.

As a surface active agent, pyridine also does a job. As little as 1% pyridine added to the solvent before filtration may decrease filtration time as much as 75%. Some otherwise impractical filtrations may become feasible through its use.

► **Catalyzes, Forms Quaternaries**—And in reactions like the condensation of carbonyl groups with active methylene groups and reduction of keto groups in the sterol field, pyridine serves as a catalyst.

Perhaps the biggest post-war boost to pyridine was its use as a wetting and waterproofing agent, through its ability to form quaternary compounds. This is exemplified in its use in Zelan and Creepryn, commercial waterproofing agents. In the case of Zelan, it's believed that pyridine is used to attach the Zelan to the fiber, but is released in curing.

Quaternary pyridine salts are also used in fungicides, fixing agents for tanning leather, printing assistance for dye-stuffs, herbicides, pharmaceuticals, germicides.

► **New Uses on the Horizon**—In line with promoting its product for even wider usage, one of the largest pyridine producers is currently working on two new applications for pyridine. But they're both still top secret.

One use, however, is eventually expected to be a major consumer of this versatile chemical and may, in the future, induce producers to up their production. 142A

Corrosion Inhibitor

Operates in oil-well atmospheres containing CO, H₂S, hydrocarbons.

UC-54 corrosion inhibitor for oil wells, pipelines and other field installations is an organic compound for use in specific environments — those including carbon monoxide, hydrogen sulfide, other sulfur compounds and hydrocarbons.

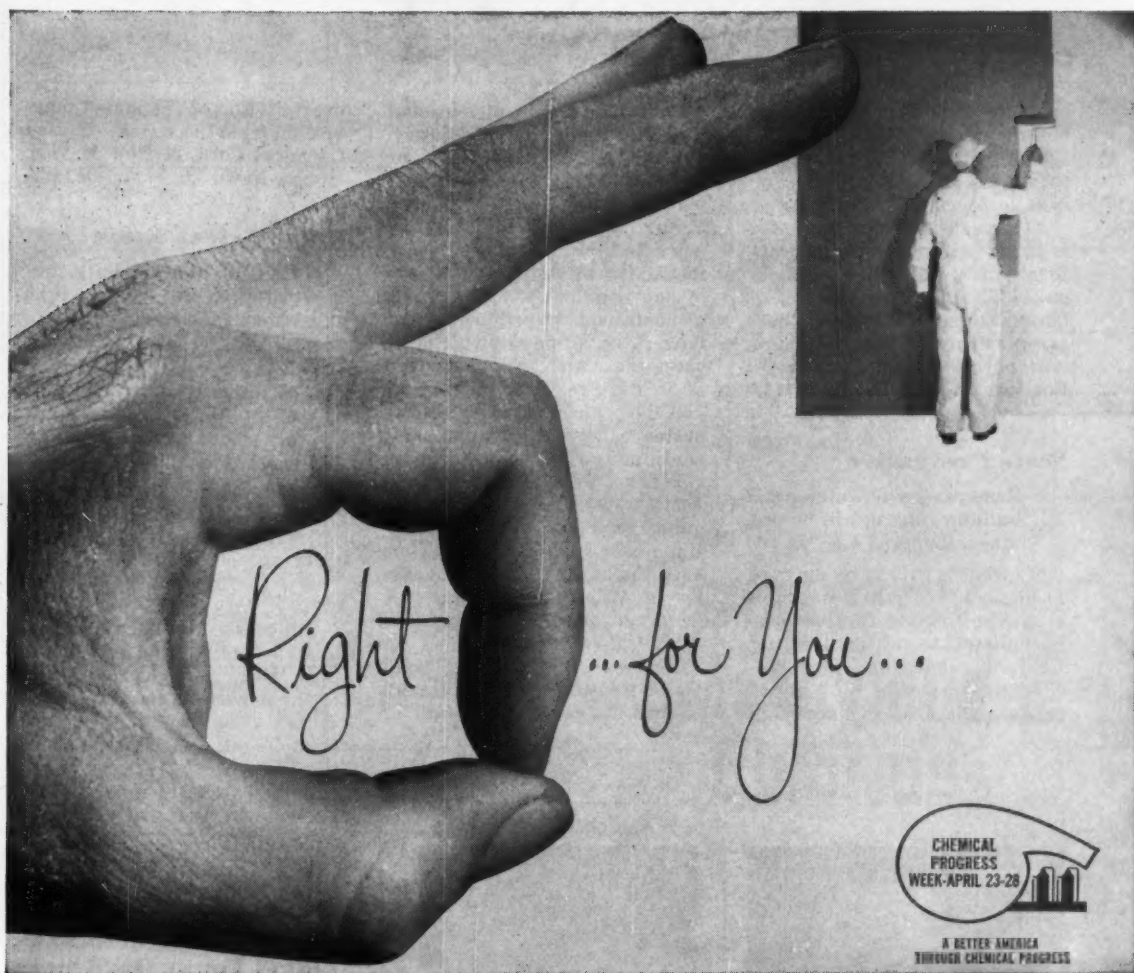
In field tests over a five-year period, UC-54 purportedly reduced corrosion by 61%, while the best available organic inhibitor reduced corrosion by 30%. Somewhat reminiscent of the postman's slogan is the manufacturer's claim for its product: "Neither high tem-

For More Information...



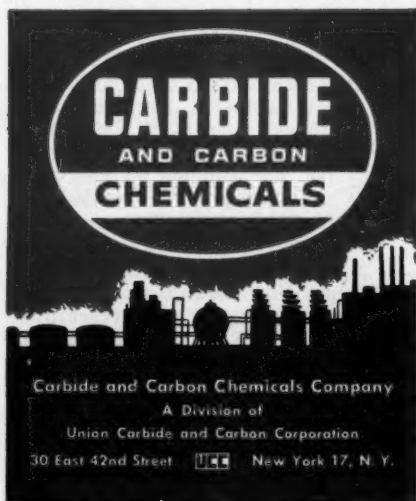
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Increased Production that keeps pace with your expanding requirements—new units at Texas City will be on stream in 1956, more than doubling this plant's capacity.

For additional information, on how NIACET vinyl acetate monomer can help you make money, call or write the Carbide and Carbon office nearest you. Offices located in 26 principal cities. In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Montreal and Toronto.

The term "Niacet" is a registered trade-mark of Union Carbide and Carbon Corporation.

perature nor pressure from carbon dioxide in oil-well brine or ocean water will hinder film formation of the inhibitor on iron surfaces."

At present, the new inhibitor is being marketed only in California on a gallon basis (\$2 per gal.). Though it will eventually be marketed elsewhere, there are no firm plans as to where, how or by whom.—Union Oil Co., Los Angeles, Calif. 144A

Scale Preventive

Removes hard water scale buildup on or in pipes, tanks, boilers, etc.

By what is said to be the most radically different principle since the introduction of polyphosphates to water treating, Ke-Tone (chelating compound) controls formation of sulfate, ferric oxide or carbonate scale.

Compared with conventional water-treatment methods (precipitation and suspension or polyphosphate "thresholding effect") Ke-Tone claims to do a better job with scale already deposited. In actual practice, it's added to water at the rate of one pound to 200,000 grains of contained water hardness or from 3 to 5 ppm.—whichever gives the highest concentration of treating reagent.

A daily check on water in the system shows a gradual but continuous rise in its hardness—because scale already deposited is disintegrating or going back into solution. Continuous or frequent blow-downs keep the hardness at reasonable levels. When the system is free of scale, hardness returns to its initial value.

Ke-Tone, unlike the usual water-treating methods, doesn't change the equilibrium to favor

precipitation of calcium or magnesium from the water.—United Chemical Corp. of New Mexico, Hobbs, N. M. 146A

Polyethylene Resin

Has greater rigidity, resistance to wear than standard materials.

Greater density is said to account for DXM-103 polyethylene resin's superiority over its competitors:

- Greater rigidity.
- Improved tensile strength.
- Increased surface hardness.
- Improved resistance to wear and staining.
- Slightly reduced permeability.

Added rigidity should appeal to manufacturers of large moldings. Easy flow characteristics of the new resin not only create a high gloss in articles molded from it but also eliminate flow lines.

A ready market for DXM-103 is seen in the production of caps and closures for acids, caustics, oils, cosmetics, food.—Bakelite Co., New York, N. Y. 146B

Liquid Epoxy Hardeners

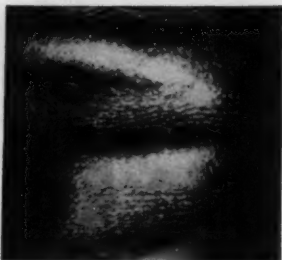
Easy to use, have long pot life, need no refrigeration.

The search for easy-to-handle liquid epoxy hardeners is over for at least one manufacturer, now that it has two successful products on the market—Dion RP-7 and Dion RP-22.

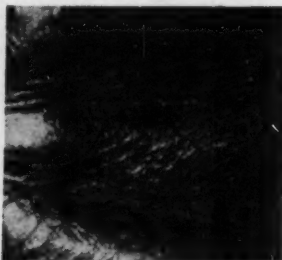
What gives these homogeneous liquids the edge over solid counterparts is that they eliminate awkward handling techniques. (Generally, solid hardeners must be melted prior to use, but sublime on heating.)

Both Dion RP-7 (based on *m*-phenylene diamine) and Dion RP-22 (based on 4,4'-methylene dianiline) have a relatively long pot life, require no refrigeration. Actually, they crystallize below 60 F. and must be warmed before use if stored for long periods of time below room temperature.

RC-7 prices range from \$5/lb. in 1-lb. glass jars down to \$3.30/lb. in 5-gallon, 55-lb. cans for



Tight grain structure versus . . .



Weatherbeaten look as . . .

Quilon Treatment Improves Leather

Long a success in imparting water resistance to felts and fabrics, Quilon chrome complex (reduced chrome salt) has now set its sights on a new field of application—side leather. And test results, to date, indicate that it may soon corner this new market, appealing both to the leather consumer and tanner.

From the consumer's viewpoint, this is how Quilon-treated shoes compare with untreated shoes: tighter grain structure, improved appearance (less cracks, creases, fissures), better shape retention, better finish

(less scuffing), improved resistance to water absorption.

From the tanner's viewpoint: water-soluble Quilon is easy to apply and geared for normal in-line production. It penetrates side leather and bonds itself chemically to the leather's protein, producing permanent fixation, improved adhesion of the finish. Finished product cost of Quilon is about 2¢ per sq. ft. of leather, but is expected to be less as more experience is gained in this new application.—E. I. du Pont de Nemours & Co., Wilmington 98, Del. 146C

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FLAMMABLE
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Write for helpful article "Methylene Chloride for Raising Solvent Flash Points . . . and Its Effect in 27 Solvents," a reprint from "Petroleum Processing," Nov., 1955.

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Company

Title

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500-lb. orders and up, f.o.b. California. Comparable prices for RP-22 are \$5 and \$2.40.—Chemical Process Co., Redwood City, Calif. 146D

Silicone Finish

For heat-cleaned glass cloth used in structural laminates.

Laminators may now be able to meet a wide range of specifications with a single type of finished glass cloth. And all because Dow Corning T-31 finish is effective with epoxy, phenolic, polyester and silicone resins.

The new finish, a solution of silicone in methyl cellosolve, can be diluted in 60 to 80 parts of water for application in conventional finishing equipment. No washing, neutralizing or curing is required—just dip and dry.

T-31 is stable as supplied or diluted, won't separate or settle out on standing. Solution requires no buffering before application. Optimum concentrations depend on the cloth's characteristics and equipment speed.

Price of T-31—\$6/lb.—is estimated to add 5¢/yd. to the material cost of finished glass cloth.—Dow Corning Corp., Midland, Mich. 148A

Auto Finishes

Eliminate car waxing for first 18 months.

Two automobile finishes—Dulux 100 and Lucite—offer a three-fold advantage over their competitors:

- Abolish the need for car waxing for at least 18 months (under normal service conditions).

- Retain their luster three times as long as conventional paints.

- Greatly reduce trouble from oil or grease staining.

Dulux 100 synthetic resin enamel comes out of the baking oven as hard as enamels in current use become after several months' aging. Marring and scratching on the production line are minimized, blister resistance and oven-bake discoloration resistance are high (no appreciable color change after

three hours at 275 F.).

Lucite acrylic lacquer, in addition to ease of maintenance, makes possible new colors and color effects by blending powder and pigment in combinations never before successfully incorporated in auto paints.

Both finishes are being used, in limited quantities, by several car manufacturers on 1956 models.—E. I. du Pont de Nemours & Co., Wilmington 98, Del. 148B



Epoxy Insulation

For on-the-job weatherproofing of electrical cable splices.

Mix and apply is the simple formula for using Thoxene Clamp-Coat, a hard-setting epoxy insulating material.

To get a weatherproof, abrasion-resistant coating with high electrical insulation, just mix Thoxene's two separate components, cover the cable splice with the formulation and allow the latter to harden (about 2 to 3½ hr.). Because one component is blue, the other yellow, completeness of mixture is indicated when a uniform green color has been obtained.

Thoxene is highly resistant to moisture, abrasion and impact. Superior adhesion to wires and clamps plus good electrical and mechanical properties are attributed to the use of Epon resins in the formulation.

Aside from its electrical ap-

plications, the new epoxy is also used as an impervious sealant for gas lines.—Shell Chemical Corp., New York 17, N. Y. 148C

Vinyl Propionate

Currently available from two new sources.

Vinyl propionate—used in emulsion paints, adhesives, laminates, protective coatings—is now available from two new sources, Celanese and Union Carbide and Carbon.

The propionate is the third vinyl monomer being offered commercially by both firms. (Celanese also supplies vinyl acetate and methyl isopropenyl ketone; Carbide furnishes vinyl butyrate and vinyl 2-ethylhexoate.)

Price: 50¢/lb., delivered in l.c.l. quantities (Celanese); 47¢/lb. in tank car quantities (Carbide).—Celanese Corp. of America, New York 16, N. Y.; Union Carbide and Carbon Corp., New York 17, N. Y. 148D

Apple Fungicide

Controls rust and scab, gives fine finish.

Because of excellent field test results, a new light-colored apple fungicide is being readied for use on 1956 crops.

The new Thylate thiram fungicide is based on thiram (one of the family of dithiocarbamate fungicides) and has these points in its favor:

- Outstanding fruit finish.
- Excellent control for apple scab.
- Good control of cedar-apple rust.

Where used as the only fungicide in the spray schedule, thiram has harmed neither foliage nor fruits—even in early-season sprays on sensitive varieties. And although proposed recommendations are limited to its use on apples, it is also being studied for control of various diseases on other fruits and certain vegetables.

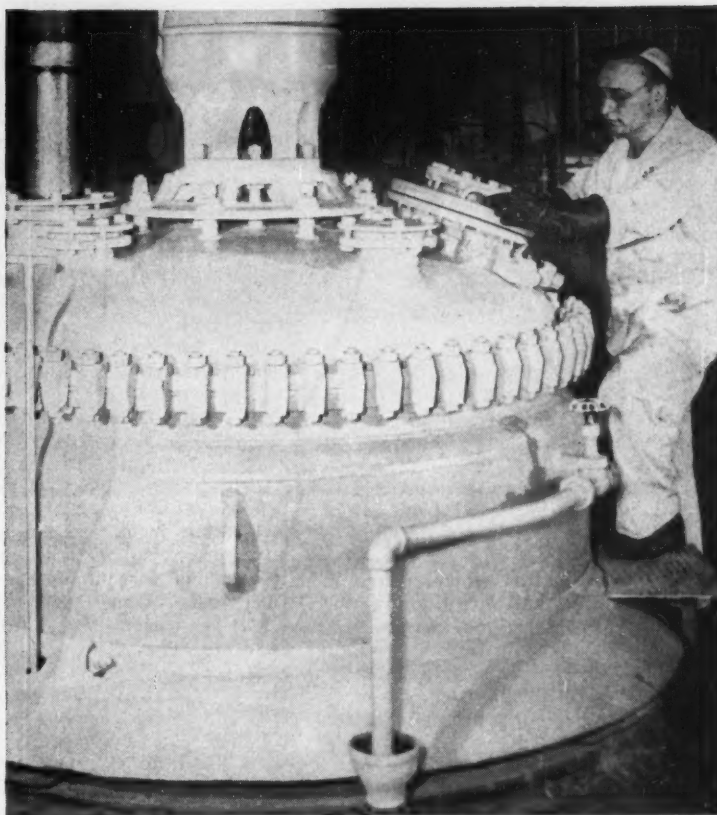
Subject to registration for commercial use and establishment of a residue tolerance, plans call for marketing Thylate thiram fungicide in 5- and

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Leading companies in many chemical processing fields regularly benefit from Baker & Adamson's "custom-made" chemical service. They find it simpler and more economical to depend on B&A's extensive manufacturing facilities and versatile production skills than to produce their own special chemical requirements.

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More than 1,000 high purity chemicals are manufactured by Baker & Adamson. They are available in quantities ranging from small bottle lots of laboratory reagents to carloads of fine chemicals. Write, on your business letterhead, for a copy of B&A Fine Chemicals Catalog.



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CE-4

CHEMICALS . . .

50-lb. bags. Recommended dose for apples: 1½ to 2 lb. per 100 gal. of spray applied in conventional scab control.—**E. I. du Pont de Nemours & Co., Wilmington 98, Del.** 148E

Metal-Silicone Paint

Withstands temperatures greater than 1,500 F.

Just as aspirin provides relief from headaches, so Alumicone offers relief for equipment which must withstand temperatures of 1,500 F. or more. For at these high temperatures, this aluminum-silicone paint will not deteriorate as normal paint films do.

Based on a silicone-alkyl resin base containing aluminum pigments, Alumicone was initially developed to increase life expectancy of aircraft exhaust systems. But it has also proved itself in various types of industrial equipment, e.g., furnaces, stove or heater door parts, high-temperature smokestacks.

The paint is simple to apply, requires no special primers or equipment. It can be sprayed or brushed directly on any clean, cold metallic surface.—**Atech, Inc., Toledo, Ohio.** 150A

Briefs

Two automotive chemicals designed to benefit fuel and conditioning systems are Alemite Kleen Treet and Alemite Cooling System Conditioner. Kleen Treet cleans carburetor jets of gums, keeps pump and fuel lines free of rust and corrosion, lubricates fuel pumps, acts as an anti-icer. Cooling System Conditioner cleans the cooling system, is a rust inhibitor and water-pump lube.—**Alemite Div., Stewart-Warner Corp., Chicago, Ill.** 150B

Low-volatility phthalate plasticizer Cabflex HS-10, is an alkyl aryl phthalate having high stability and permanence. It requires no antioxidant, is highly resistant to oxidation and heat breakdown, has electrical properties superior to DOP (dioctyl phthalate). HS-10 is com-

patible with cellulose acetate butyrate, cellulose nitrate, polymethyl methacrylate, polystyrene, polyvinyl chloride, polyvinyl chloride acetate and polyvinylidene chloride.—**Godfrey L. Cabot, Inc., Boston 10, Mass.** 150C

A miticide to control the tiny insects (mites) which have become a serious problem to commercial fruit growers will soon be on the market under the name of Genite EM-923. A single application of Genite (2, 4-dichloro phenyl ester benzene sulfonic acid) will kill mites in all stages of development, but is non-toxic to beneficial insects and bees.

—**General Chemical Div., Allied Chemical & Dye Corp., New York 6, N. Y.** 150D

Series of electrical grade polyethylene resins meets a variety of electrical specifications including line wire covering, high frequency and high voltage insulation. Three compounds in the new Petrothene(R) series—300, 301, 302—are available in uncompounded and compounded grades. Uncompounded 300 and 301 can also be used in applications calling for high molecular weight material, high toughness and resistance to environmental stress cracking.—**U. S. Industrial Chemicals Co., New York 16, N. Y.** 150E

Colorimetric and chromatographic reagent, Acid Rubeanic AR (dithiooxamide) is a complexing agent which reacts with a number of metallic ions to form colored, insoluble rubeanates. It's particularly sensitive in copper determinations.—**Malinkrodt Chemical Works, St. Louis 7, Mo.** 150F

Surface-resistant coating, Ston-treet, protects macadam, asphalt concrete or black top from grease and gasoline, salt spray, alkalis, brines, atmospheric acids, water penetration, smoke and fumes. It can be applied by brush or spray over damp surfaces, producing a non-tacky film which isn't slippery—even when wet.—**Stonhard Co., Philadelphia 23, Pa.** 150G

Semifluid synthetic grease is suitable for a wide range of uses involving low temperatures and icing conditions. It includes rust-inhibiting and anti-wear additives, is compatible with oil-resistant rubber used for O- and T-rings in pneumatic feeder systems for aircraft machine guns.—**Naval Research Laboratories, Washington, D. C.** 150H

Filled epoxy-base casting compound has been specifically developed to meet requirements of MIL-T-27A specification—for potting and encapsulating electrical equipment like transformers, power bushings, etc. Called Hysol 6600, this epoxy is a soft solid which melts to an easily handled, low viscosity liquid. It's particularly suited for applications requiring a slight degree of resiliency, good thermal conductance and withstands temperatures up to 150 C.—**Houghton Laboratories, Inc., Olean, N. Y.** 150I

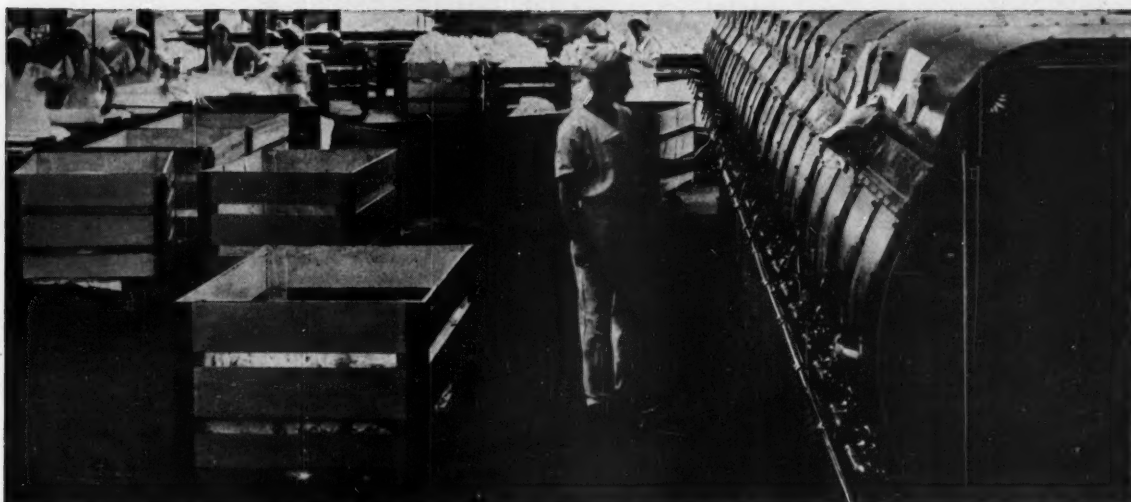
Lubricant additive, Hyperoil, is said to increase the efficiency and extend the life of any type and weight of industrial lubricant. Addition of Hyperoil to samples of various oils produced these results: cutting oil—2%-by-volume addition increased registered load-carrying capacity of the oil by 144%; water-soluble cutting oil—2%-by-volume addition increased coolant life by 75%; working efficiency by 35%; hydraulic oil—5%-by-volume addition increased pump life by 250%.—**Destiny Products Co., Detroit 2, Mich.** 150J

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CHEMICAL ENGINEERING—April 1956



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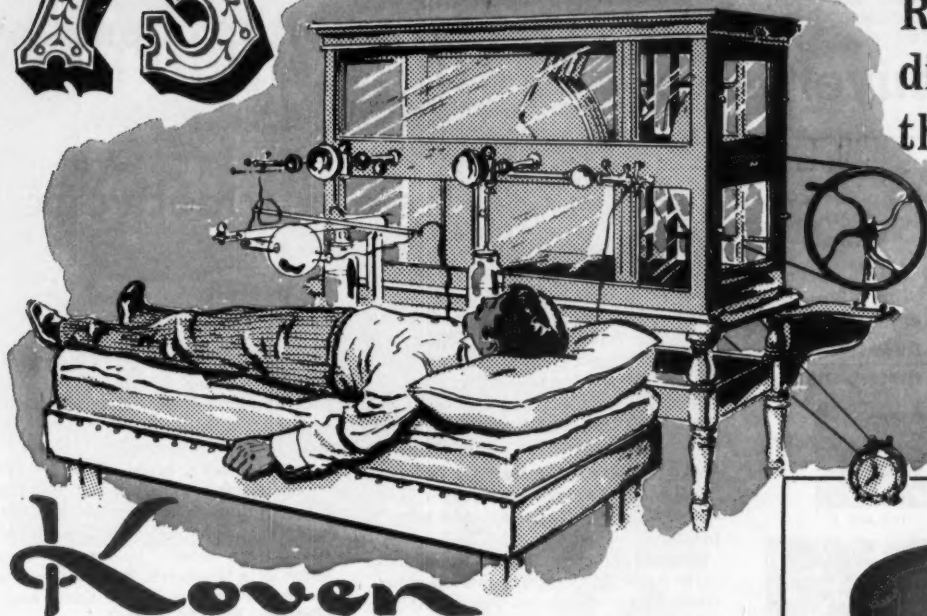
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the x-ray



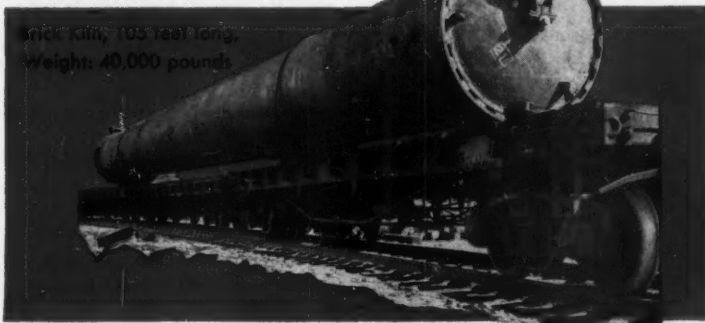
Koven

was making individualized chemical equipment

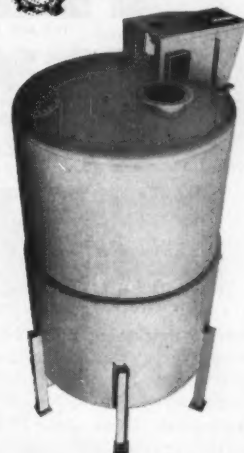
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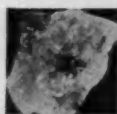
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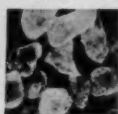
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Fire-safe Ductwork



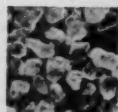
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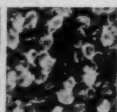
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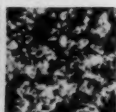
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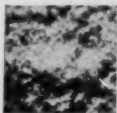
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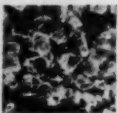
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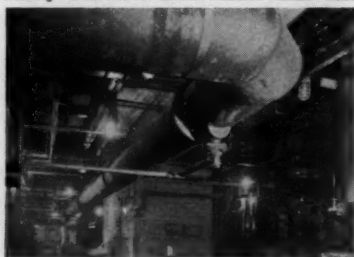
It's made with glass-reinforced HETRON®, a Hooker polyester that handles most common acids and many common organic materials and gases, wet or dry, with little or no corrosion.

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Add to fire- and corrosion-resistance these other qualities of HETRON: great structural, flexural, tensile, and impact strength; high resistance to heat and weathering; very low water absorption. With all these virtues, HETRON, in the long run, costs less than anything else for handling corrosive fumes and smoke.

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For technical data on products mentioned on this page, check here:

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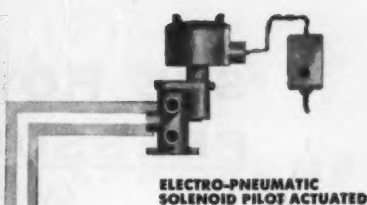
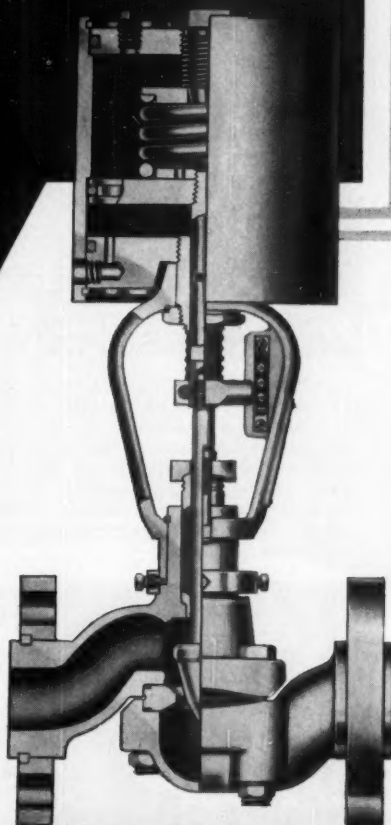
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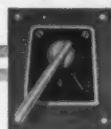
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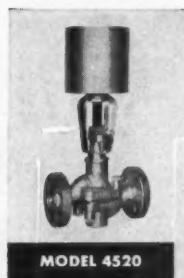
ELECTRO-PNEUMATIC
SOLENOID PILOT ACTUATED



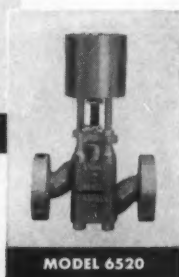
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THE ANNIN COMPANY

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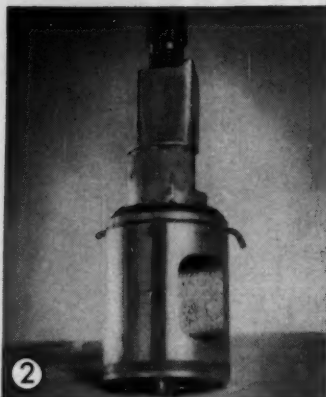
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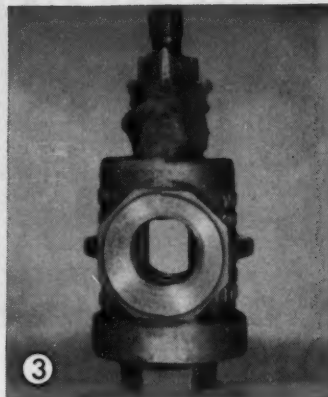
HOMESTEAD *lubricated* PLUG VALVES



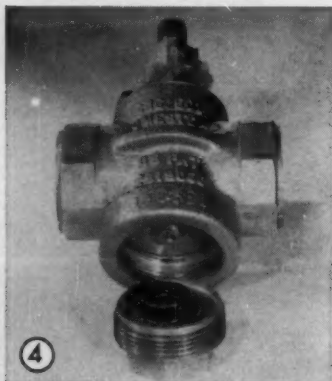
1 This plug was removed from a Homestead Valve just after starting lubrication, and before all sealing areas were filled with lubricant. Note that pressurized lubricant continues to extrude through feeder holes. Momentary downward movement of plug at start of each lubrication, gives assurance that plug is always free to turn.



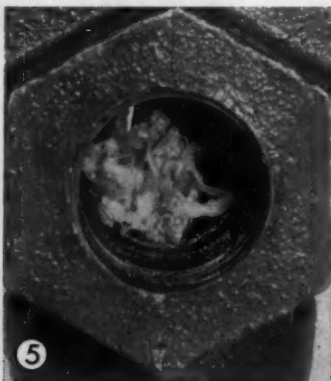
2 The plug was again withdrawn from the valve body just after a ring of lubricant around the stem indicated that the lubricant system was full. Note that all lubricant grooves are filled. The entire plug surface is coated with lubricant. Lubricant is well packed in the stem sealing area above the plug.



3 Now valve has been purposely over-lubricated as indicated by excess lubricant around stem. Note that with *controlled* pressurized lubrication there is no extrusion or seepage of lubricant into valve port opening. This means no waste, no contamination of line fluids, no clogging of low pressure lines with lubricant, or fouling of meters, orifices, etc.



4 Also, in the Homestead Valve with *controlled* lubrication, you will note that even though the valve has been over-lubricated, lubricant comes only to the bottom edge of the plug, and is not wasted by discharging in quantity into the bottom chamber.



5 Now, see for yourself the risk involved when a valve which does not have Homestead's *controlled* Pressurized Lubrication, is over-lubricated. Note lubricant has been forced into the port opening. It can contaminate line fluids, foul meters or orifices, or even block low pressure lines!

* Unretouched photos.

These are but a few of the many advantages of Homestead's *controlled* pressurized lubrication that guarantee lowest cost valve service.

Reference Book 39-5 has the full story—twenty-eight pages of engineering facts, sizes, types, dimensions, etc. Ask for your copy today. There is no obligation.

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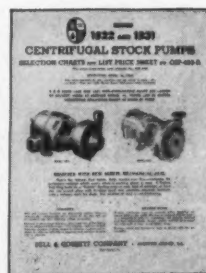
- ★ **Anti-Friction Roller Bearings.** Timken Bearings handle thrust and radial loads for smoother, quieter, more efficient operation.
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What's New

IN STAINLESS & PLASTICS FOR CHEMICAL PROCESSING

In the news today are many developments of interest to men who specify or buy steel or plastics for chemical processes. Ways in which you can raise efficiency or lower costs in your operations may be suggested by this summary.

NOTE ON D. O. RATINGS—You can help to assure future availability of nickel-bearing stainless by giving us your D.O. ratings when you have them. With the nickel supply growing tighter, this is an important safeguard you should not overlook.

STAINLESS PIPE FOR WELDING APPLICATIONS—Now there's no need to wait for mill deliveries or to use expensive stabilized types when you want stainless pipe suitable for welding. Type 304L pipe, an extra low carbon type that eliminates the need for stress relieving after welding, has recently been added to Ryerson stocks. Size range: Schedule 40 welded pipe in commonly used sizes from $\frac{1}{4}$ " through 2". Schedule 40 seamless in 3", 4" and 6" pipe sizes.

NEW TYPE PVC PLASTIC—Now, for the first time, you can get time-tested, job-proved PVC plastic, produced to the original formula developed by European scientists early in World War II. Ryertex-Omicron PVC sheets, pipe, valves and fittings, available only from Ryerson, resist attack by acids, alkalis, salt solutions, alcohols, etc. Sheets can be formed and welded like metal. Remarkable corrosion resistance plus light weight and ease of installation make Ryertex-Omicron PVC ideal for tanks and troughs, conveyors, agitators, fume systems, filter plates, underground drain work, etc. For complete data on properties, resistance, etc., write for booklet 80-3.

EASY-TO-WELD STAINLESS PLATES AND SHEETS, TOO! Both stainless sheets and plates in Type 304L and Type 316L have recently been added to Ryerson stocks. In applications involving welding and stress relieving, where carbide precipitation may occur, these extra-low carbon steels can often replace expensive stabilized types.

EXTRA-LARGE STAINLESS PLATES & SHEETS—You can save on welding costs and improve the appearance of big fabricated pieces now that you can get stainless plates and sheets from Ryerson stocks in extra-large sizes. Types on hand: Plates—304, 304L, 316 and 316L in 96" widths up to an inch thick, and 80" widths even heavier. Sheets—304, size 72" x 144", in 10, 11, 12, 14 and 16 gauges.

STEEL-WALLED AND ROOFED BUILDINGS (to resist chemical fumes) take on a handsome new look when you use stainless steel siding in mansard pattern, now available for quick shipment from Ryerson. The mansard pattern of widely spaced corrugations makes an unusually attractive wall and loss in total sheet area from pattern formation is slight—about the same as with 2 $\frac{1}{2}$ " corrugated, previously the most economical pattern you could use. New Bulletin 70-5 on request.

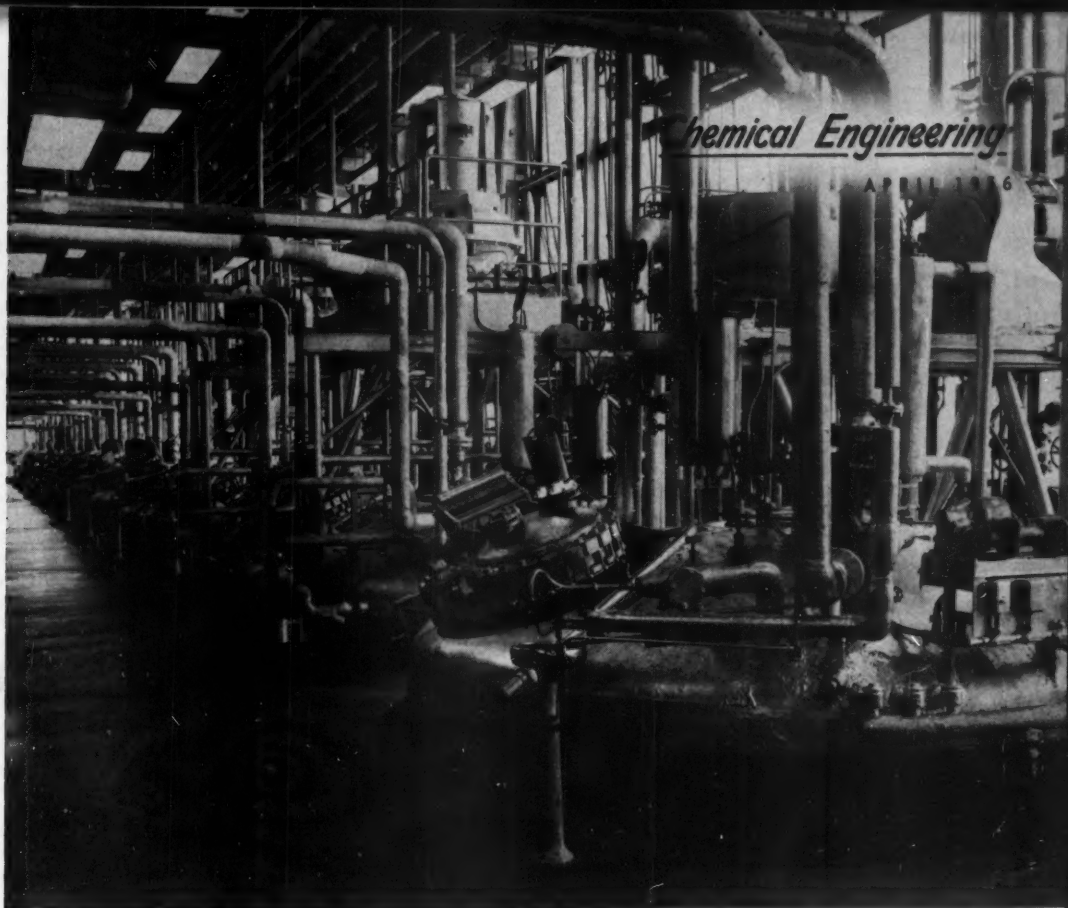
SAVE 7 $\frac{1}{2}$ ¢ TO 10¢ A LB. ON STAINLESS—Where corrosion is not too severe, one of the 400 series of straight-chrome stainless steels will often serve quite as well as one of the nickel-bearing types—and the straight-chrome types cost 7 $\frac{1}{2}$ ¢ to 10¢ a pound less! Ryerson has the nation's largest stocks of straight-chrome stainless including type 430 sheets in many gauges and sizes, type 410 plate and type 416 bars. Technical data on request.



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Chemical Engineering

APRIL 1956

CHEMICAL TECHNOLOGY OF . . .

Fermentation

What fermentation is doing today p. 160

How it's handled p. 164

What its tools are p. 172

How to get more out of it p. 172

ELMER GADEN, JR., Columbia University

In putting this report together your author admits to having a special axe to grind. He—and we—would dispel some of the aura of mystery which pervades the fermentation industries. This haze has been obscuring the contributions that sound engineering is making to fermentation technology. It hampers further efforts which engineering could and should make.

Some of the mystery has rubbed off on the chemical engineer who works with fermentation processes, has made him seem a special

breed of cat. Yet he need be no more of a specialist than the petrochemical engineer need be a specialist. He is first and foremost a chemical engineer, with just enough knowledge of the behavior of microorganisms (and not as much is needed as you might think) to understand the demands which the "bugs" impose upon him. His basic training equips him to meet those demands.

This report will give the chemical engineer within and without the realm of fermentation a truer perspective of the job which he can do.

Fermentation Technology: Today's Jobs

Not long ago fermentation was pretty much a one-track route. Now it ranges from plasma substitutes to metal cleaners.

The term "fermentation" has a very specific biochemical meaning; it refers to the *anaerobic* oxidation of carbohydrates and was therefore quite properly applied to most of the pre-1940 commercial processes. Carbohydrate oxidation in the presence of oxygen is called "respiration" and it is in this category that most present operations fall.

Nevertheless, industrial practice has largely obliterated this distinction and "fermentation" now applies to any microbiological process for chemical production. As such it falls squarely in the province of chemical engineering.

Catalysis by Enzymes

We can characterize fermentation processes even more specifically if we note that the essential feature in which they differ from other chemical processes is the nature of the particular catalysts employed—enzymes.

These highly complex protein-substances exhibit amazing catalytic activity, both in type and intensity. Weight for weight their ability to catalyze reactions is many thousands of times as great as that of more conventional agents like metal oxides, silica, etc.

Although microorganisms are the usual suppliers of these enzymes, they are not the only source. Enzymes are everywhere associated with living matter in seemingly endless variety, and some experiments using animal glands and other tissues as sources have been reported. Nevertheless the convenience of handling microorganisms and the rapidity with which they grow and produce the desired catalytic activity have made them difficult to surpass for commercial application.

Energy Relationships

Another way in which fermentation differs from many of the more familiar chemical manufacturing

procedures is in the energy relationships involved.

If a reaction requires an input of energy ($\Delta F = +$) in order to proceed, this requirement is ordinarily met by raising the temperature of the reaction system. Since the complicated molecules, like enzymes, found in biological reaction systems are so easily destroyed by heat, this manner of energy input is not feasible. Instead nature has provided a series of remarkably efficient energy-transfer mechanisms for coupling the output of free energy-yielding reactions to those requiring input.

Fermentations therefore require a "chemical" source, usually some carbohydrate like glucose, sucrose or starch, which is readily oxidized by a portion of the enzyme-catalysts present. The energy provided may then be used, if the proper transfer mechanisms are present, to "drive" a reaction of synthesis.

In this sense the system bears at least a reasonable resemblance to the familiar galvanic cell with its "driving" ($\Delta F = -$) and "driven" reactions ($\Delta F = +$).

From the chemical engineering viewpoint, then, fermentations constitute a particular type of chemical process in which desired reactions, either of conversion or synthesis, are brought about by systems of complex enzyme-catalysts produced by growing organisms. Energy requirements for the processes involved, including the growth of cells and synthesis of enzyme-catalysts themselves, are provided by the oxidation of carbohydrates and other substances.

In other words, there is nothing "special" or "mysterious" about fermentation reaction systems. They differ from more conventional ones only in the highly complex and delicate nature of the catalysts employed. (An additional, and most important, complication: The catalysts responsible for particular reactions of conversion or synthesis and the factors governing their for-

Centuries-Old Art Picks Up Engineering Knowhow

Fermentation is an old and honored art. Its role in food and beverage preparation antedates by far the written records of our civilization. Despite this antiquity—or perhaps because of it—fermentation is notable among man's technological arts for the slowness with which it has progressed. Until very recently, in fact, the techniques employed were identical in essence, except for some manipulative details, general cleanliness, and equipment scale, with those used centuries before.

During the first decades of this century fermentation began to move slowly but surely into the realm of "industrial chemistry." Chemicals of commerce were prepared in increasing number through the natural activities of various yeasts, molds and bacteria. But the extent of chemical production by these means was still very limited until the introduction of the great solvent fermentation processes—for butanol, acetone and the rest—during and just after World War I.

It is often said that this surge of commercial application caused fermentation to be put on a "scientific" basis; it would probably be more accurate to say that microbiological processes were brought under more rational technological control. Both microbiology and biochemistry had made great strides in the preceding years and techniques for observing and measuring the changes occurring in fermentations were quite well developed. Some knowledge of the general nature of complex biochemical reaction systems was also being accumulated.

On the whole, however, there was little or no understanding of the basic influences of the many process variables which could be enumerated. It might be said that fermentations, once started, were best left alone.

As the market for solvent alco-

mation in growing organisms are generally unknown.)

Fermentation Reactions

It has been more or less common in the literature to group fermentation processes according to either the products formed—e.g. antibi-

hols expanded rapidly following World War I, fermentation technology followed. This "hey-day" of industrial microbiology was, however, destined to be short, albeit glorious. The products were almost all simple compounds of low unit costs—alcohols, ketones, and some organic acids—and competition from direct synthesis based on natural gas and petroleum was not long in coming.

Despite the respite afforded by World War II, when all production facilities, including fermentation, were expanded, the future for microbiological processes was dark indeed until a series of startling discoveries in chemotherapy—the advent of antibiotics—reestablished them on a sound economic footing.

Since 1945, when the antibiotics reached the civilian market, fermentation technology has staged a remarkable comeback and, incidentally, undergone some rather revolutionary changes. As a result of these it has lost much of its earlier complexion and emerged as an important method for commercial chemical production.

• The most notable change has been in the types of materials produced by fermentation methods. In the period of 1920-40 conversion of carbohydrates to cheap, structurally simple organics was the characteristic fermentation process. Now, on the other hand, biosynthesis of complex molecules of high unit cost is the rule.

In the earlier decades industrial solvents—now mostly prepared from petroleum derivatives—accounted for the greater part of fermentation capacity. For the complex substances fermented today, direct chemical synthesis, though possible, is often not competitive.

This trend is quite evident when the major industrial fermentation products of the two periods, 1920-40 and 1945 to present, are compared as in the table below. The fact that some fairly cheap chemicals like citric and gluconic acids continue as fermentation products seems to indicate that structural complexity rather than price is the factor determining the feasibility of fermentation methods.

Two other significant factors also serve to differentiate present practices from the earlier ones:

• Practically all current processes are "aerobic," requiring a considerable degree of forced aeration. In contrast, the pre-1940 processes were mostly "anaerobic" (absence of oxygen) and required no aeration, being in some cases adversely affected by contact with oxygen.

• While a high level of cleanliness has always been essential in fermentation, most of the older processes could stand a little chance contamination so long as the primary agent was not overwhelmed. Now, however, "pure culture" operation, or the complete elimination of all microorganisms other than the primary fermentation

agent, is now considered to be an absolute requirement. This change has naturally affected the design of fermentation equipment.

Today's Processes

The major commercial fermentation processes now in use are summarized in Table I along with characteristic process conditions, yields, etc. The data given are intended more for illustration and example than for completeness and accuracy of detail. Published information—particularly for antibiotic and other pharmaceutical processes—is rarely more than an approximation to the actual conditions employed and results obtained anyway.

Some of the processes listed (butanol-acetone and ethanol) are on their way out, succumbing to competition from direct synthesis. Others, although studied carefully, have never been commercially applied (2,3-butanediol) and therefore are not included in this compilation. Where several procedures are possible, the most common one or two only have been listed.

A new and promising application of the fermentation technique is the accomplishment of specific steps in a lengthy synthesis by microbiological means. Cortisone, hydrocortisone and related hormones are examples of products prepared by this happy combination of microbiological with more conventional methods. The potential employment of this approach can, however, only be guessed.

Fermentation Processing Shifts to More Complex and More Costly Chemicals

1920-1940			1945-present		
Product	Formula Weight	Current Price/Lb.*	Product	Formula Weight	Current Price/Lb.*
Acetone.....	58	\$0.07	Gluconic acid.....	196	\$0.15
n-Butanol.....	74	0.13	Penicillin, potassium, tablet grade.....	334	65
Ethanol, absolute, tax-free.....	46	0.07	Riboflavin, feed grade, 4gm./lb.....	376	28
Isopropanol.....	60	0.06	Streptomycin, sulfate, bulk.....	581	95
Lactic acid, edible.....	90	0.36	Terramycin, feed grade, bulk.....	460	68
Citric acid, anhyd.....	192	0.29	Vitamin B ₁₂ , oral grade, solid concentrate	1,500(est.)	84,000
			Citric acid.....	192	0.29

* Cost of active ingredient

otics, organic acids, vitamins—or the organism employed—yeasts, molds or bacteria.

This approach, though useful for some purposes, is not very satisfying to the chemical engineer. For our needs a classification in terms of the essential reaction systems involved in product formation seems

more reasonable. On this basis certain similarities between like reaction types may be expected.

Accordingly the fermentation processes listed in Table I have been subdivided into four groups: (1) simple and (2) complex oxidation-reduction systems, (3) polymerizations and (4) biosyntheses.

Obviously these categories are not rigorous, but they are convenient.

To illustrate better the nature of these various reaction types, several examples are detailed in Fig. 1. The reactions selected are those whose mechanisms are reasonably understood, although for the case of biosynthesis our comprehension

of reaction pathways is still woefully inadequate. Each of these reaction types will now be discussed more fully.

Simple oxidation-reduction: Products are formed directly from a specific reactant (substrate) by a single oxidation or reduction. Chemically, this type may be considered the simplest of fermentation reactions and usually exhibits very high efficiency in terms of percent conversion (see Table I). The very interesting and rapidly expanding group of microbiological steroid transformations fall almost entirely in this class, the reactions reported so far being chiefly hydroxylations.

Complex oxidation-reduction: In this type of reaction products again arise from the oxidation of a specific reactant or substrate. The oxidation process is, however, complex with many steps, each catalyzed by one or more specific enzymes, and with many intermediate compounds formed. In some cases the product is one of these intermediates, accumulating because of differences in reaction rates or the absence of some factor or condition essential for further oxidation. In others the desired product is formed through a condensation or other interaction between different oxidation products of the same substrate. This last is believed to be the mechanism by which citric acid, the example cited in Fig. 1, is produced.

Polymerization: Again the products are formed from a primary reactant, but by a polymerization rather than an oxidation mechanism. While polymer production of this sort is quite common in microorganisms, only "dextran," a mixture of high molecular weight polysaccharides, has ever been produced commercially. This is the example used in Fig. 1.

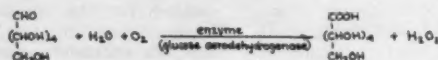
Biosynthesis: The final, and at present most important, class of fermentation reactions is biosynthesis. In systems of this type complex molecular structures are synthesized from materials provided through reactions largely unknown.

For some cases it has been recognized that the formation of a particular product can be promoted by adding to the reaction mixture substances which contain portions of the desired molecular structure. Such substances are called "precursors." An outstanding example is the addition of substances containing the benzyl ($C_6H_5 \cdot CH_2-$)

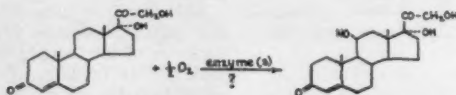
Unit Processing With Fermentation—Fig. 1

Simple Oxidation-Reduction

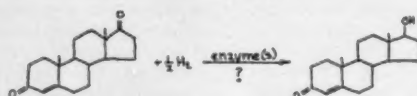
1. Oxidation of glucose to gluconic acid



2. Hydroxylation of 11-desoxy-17 α -hydroxycorticosterone to hydrocortisone



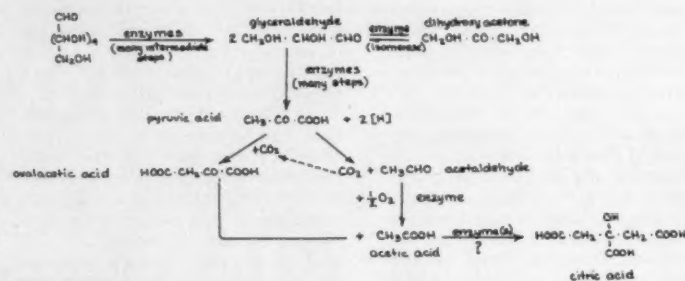
3. Reduction of Δ 4-androstenedione to testosterone



Complex Oxidation-Reduction

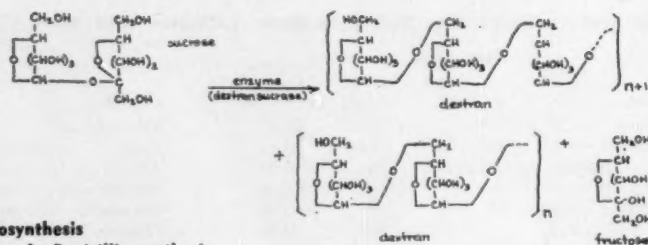
1. Conversion of glucose to citric acid

(the usual raw material is sucrose; glucose is formed by hydrolysis)



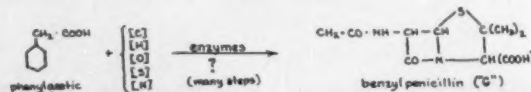
Polymerization

1. Conversion of sucrose to dextran polymers



Biosynthesis

1. Penicillin synthesis



group to penicillin fermentations, thereby greatly increasing the proportion of benzylpenicillin formed. As yet no clear picture of how the rest of the penicillin molecule is formed has been provided. This

partial knowledge of penicillin biosynthesis is also illustrated in Fig. 1.

A fairly considerable portion of the fermentation industry concerns itself with the production of micro-

Today's Commercial Fermentation Processes—Table I

Product	Raw Materials (numbers indicate a choice)	Enzyme-Producing Organism (numbers indicate a choice)	Temp., C.	pH	Aeration	Time, Hr.	% Conversion	Product Concentration
Simple Oxidation-Reduction Systems								
Gluconic acid....	glucose, nitrogen supplements... trace elements.....	1. <i>Aspergillus niger</i> 2. <i>Acetobacter suboxydans</i> ...	33 30-34	6.5 6.5	high high	24-30 24-36	90-95 ¹ 90-95 ¹	25-30% 15%
L-Sorbose ¹	sorbital, salts, nitrogen supplement	<i>Acetobacter suboxydans</i>	30-35	6.0	very high	15-30	98	10-20%
Hydroxylated..... steroids.....	steroids, glucose, nitrogen..... supplement, salts.....	1. <i>Rhizopus</i> sp..... 2. <i>Aspergillus</i> sp..... 3. <i>Streptomyces</i> sp. 4. <i>Curvularia</i> sp. etc.	24-30	6-7	moderate to high	12-48	25-60	0.1 gm./liter
Complex Oxidation-Reduction Systems								
Ethanol.....	1. molasses (sucrose & invert sugar) 2. saccharified grains (glucose).	<i>Saccharomyces cerevisiae</i> (yeast)	27-35 27-32	4-5 4-5	none none	36-72 40-60	85-95 ¹ 85-95 ¹	6-9% 6-9%
Butanol-acetone ² ...	1. molasses, ammonia..... 2. corn.....	<i>Clostridium saccharo-acetobu- tylicum</i> <i>Clostridium acetobutylicum</i>	30-35 37	5.8-6.4 5.8-6.4	none none	40-45 40-45	25-32 ⁴ 20-30 ⁴	1.5-2.5% 1.5-2.5%
Lactic acid.....	1. glucose, nitrogen supplement. 2. whey (lactose).....	<i>Lactobacillus delbrückii</i> <i>Lactobacillus bulgaricus</i>	45 43	5.5-6.5 5.5-6.5	none none	96-140 48	90 90	10% 10%
Citric acid.....	molasses (sucrose), refined sucrose, nitrogen supplement, salts	<i>Aspergillus niger</i>	28-30	4-6	high	72-240	50-80	10-12%
Itaconic acid.....	molasses or invert sugar, glucose, nitrogen supplement, salts	<i>Aspergillus terreus</i>	35	1.8-2.3	low to moderate	48-72	20-60	3-5%
Polymerizations								
Dextrans	sucrose, salts, nitrogen supplement	<i>Leuconostoc mesenteroides</i> ...	20-30	5-7	none	8-48	25-35	0.5%
Biosyntheses								
Riboflavin.....	grain stillage, meals, glucose, salts, nitrogen supplements.....	1. <i>Eremothecium ashbyii</i> 2. <i>Ashbya gossypii</i>	28-32	5.5-6.5	high	85-120		1-2 gm./liter
Cobalamin..... (Vitamin B ₁₂)	glucose, grain meals, nitrogen... supplements, Co ⁺⁺ , salts.....	1. <i>Streptomyces griseus</i> 2. <i>Streptomyces olivaceus</i> ...	26-30 28-30	6.5-7 7	high high	60-70 65-120		0.3-0.6 gm./liter 1-3 gm./liter
Benzyl penicillin.. (penicillin G)	lactose, glucose, corn steep liquor, salts, phenylacetic acid	<i>Penicillium chrysogenum</i>	22-28	6-7	high	100-120		2-3 gm./liter
Streptomycin.....	glucose, soy bean meal, nitrogen supplements, salts	<i>Streptomyces griseus</i>	25-30	6.5-7	high	60-80		1.5-2.5 gm./liter
Chloramphenicol.. (chloromycetin)	starch, glycerol, nitrogen..... supplement, salts	<i>Streptomyces venezuelae</i>	27-28	6.5-7.5	high	72		0.3-0.5 gm./liter
Chlorotetracycline (aureomycin)	sucrose, corn steep liquor, salts	<i>Streptomyces aureofaciens</i>	26-28	6.2	high	48-72		1.3-2.5 gm./liter
Oxytetracycline... (terramycin)	starch, soy bean meal, salts.....	<i>Streptomyces rimosus</i>	24-30	7	high	48		1 + gm./liter
Bacitracin.....	glucose, sucrose, nitrogen supple- ment	<i>Bacillus licheniformis</i>	37	6-7	high	36-48		1.5 gm./liter
Amylase (starch- hydrolysis enzymes)	grain, starch, stillage, salts.....	1. <i>Aspergillus niger</i> 2. <i>Aspergillus oryzae</i>	30	5	high	65-135		75-100 units (enzyme activity) ⁶
Yeast.....	1. molasses nitrogen supplement. 2. sulfate liquor, salts.....	<i>Saccharomyces cerevisiae</i> <i>Torulopsis utilis</i>	25-30 32-34	4-5 4.5-6	very high very high	10-20 continuous	35-40 ³ 45	5 gm./liter 5-7 gm. liter

Footnotes: (1) an intermediate in ascorbic acid manufacture; (2) solvents produced in about a 3 to 1 ratio; (3) based on total sugar supplied; (4) based on sugar (sucrose) equivalent supplied; (5) based on grain meal supplied; (6) "units of enzyme activity"—equivalent weights unknown.

organisms themselves. Baker's yeast propagation (growth), for example, is one of the oldest "fermentation" processes. More recently organisms, including bacteria and molds, have been grown for their food

value (vitamins, feed supplements) or to obtain particular enzymes of industrial value like the starch-splitting amylases.

Processes of this type though usually grouped apart have been

included in biosynthesis here (Table I). The primary action is synthesis of proteins—tissue and enzymes—or other complex molecular structures and so it seems perfectly consistent to place them so.

Fermentation Technology: Process Steps

The processor makes his catalysts en route, adds promoters for the catalysts, sterilizes nearly everything in sight.

Batchwise operation of fermentation processes is almost exclusively the case at present; continuous methods have so far had a very limited application.

In the batch process a previously developed culture ("seed" or "inoculum") of the organism is added to sterilized medium in the fermentation vessel (reactor). Conditions, particularly temperature and pH, are held to values considered optimum and sterile air is blown into the mass as required. Most commercial fermentation tanks also employ substantial mechanical agitation to supplement the aeration.

A typical fermentation process flow sheet is presented in Fig. 2. While any given process may differ from this layout in particulars, it still summarizes the important features of the batch process.



ELMER GADEN, JR., Associate Professor of Chemical Engineering at Columbia, has been interested in the engineering aspects of industrial biochemistry and microbiology most of his career. He worked for Chas. Pfizer in 1948-49, got his PhD from Columbia (1949) and joined the faculty to set up a "biochemical engineering" program. Dr. Gaden is director of microbiological radiation sterilization studies at Columbia and a member of the ACS's Fermentation Advisory Board.

Medium Preparation

The medium must provide all the materials required for proper operation of the fermentation reaction system as well as for synthesis of a major fraction of the catalysts employed. These essential ingredients with some typical examples are:

Energy Source—provides free energy (from oxidation) to drive reactions of tissue, enzyme, and product synthesis. Usually a carbohydrate, but proteins and fats are also oxidized to provide energy. Examples: glucose in gluconic acid production; lactose in penicillin biosynthesis; sucrose in citric acid production.

Nitrogen Source—provides nitrogen for formation of cell protein and enzymes. Complex materials like proteins and their hydrolysis products (amino acids) are common but inorganic sources (ammonia, nitrates) may be used. Examples: corn steep liquor in penicillin biosynthesis; ammonia in yeast production.

Substrate—primary reactant from which product is formed by some direct chemical action. Examples: glucose in gluconic acid production; compound S in hydrocortisone production.

Precursor—specific reactant contributing some structural grouping present in the desired product. Examples: phenylacetic acid in penicillin biosynthesis; cobalt ion in cobalamin biosynthesis.

Cofactors (Trace Substances)—Catalyst promoters, essential materials required in small amounts for maximum activity of enzyme systems, etc. They include metals, vitamins, and a host of complex chemical substances. Examples: traces of magnesium and zinc ions used in most fermentations.

In large-scale operations the medium components are generally combined with all or part of the process water to be used, and the mixture

adjusted to a desired pH value in a special "batching" area. Required amounts may then be pumped to the fermentation vessels. In smaller installations, direct addition of ingredients and process water to the tank, followed by pH adjustment, is used.

Medium Sterilization

Freedom from contamination is essential if pure culture operation is to be maintained. Foreign organisms must be destroyed and their re-entry prevented. The first is accomplished by sterilization of the medium and equipment; the second by proper design and operation of the whole system.

Although many agents are available for sterilization none has yet been proposed which can compete with steam. The economy, simplicity and surety of steam sterilization, as well as the vast accumulation of practical experience in its use, make it hard to beat.

Furthermore, heat sterilization does more than just eliminate foreign organisms. It cooks and solubilizes complex organic matter like grain meals (starch and proteins) present in the medium. Hydrolysis of these substances makes them more readily available for use in enzyme-catalyzed reactions.

Of course there is also some destruction of complex substances, vitamins for example, required in the medium. Thus, any sterilization procedure must represent a reasonable compromise between these effects.

In order to establish a required sterilization treatment, data are needed on the thermal destruction of microorganisms in the particular medium being studied. This may be obtained by fairly routine procedures and is usually presented in the manner of Fig. 3. The time required to destroy all organisms present is found to be a logarithmic function of the sterilization temperature. At the boiling point (212F.) for atmospheric pressure, 108 min. are needed, while at 290F. sterilization is accomplished in 2.5 min.

Batch Sterilization

At present most plants employ batch sterilization for all or part of their operations.

In such a scheme the fermenter,

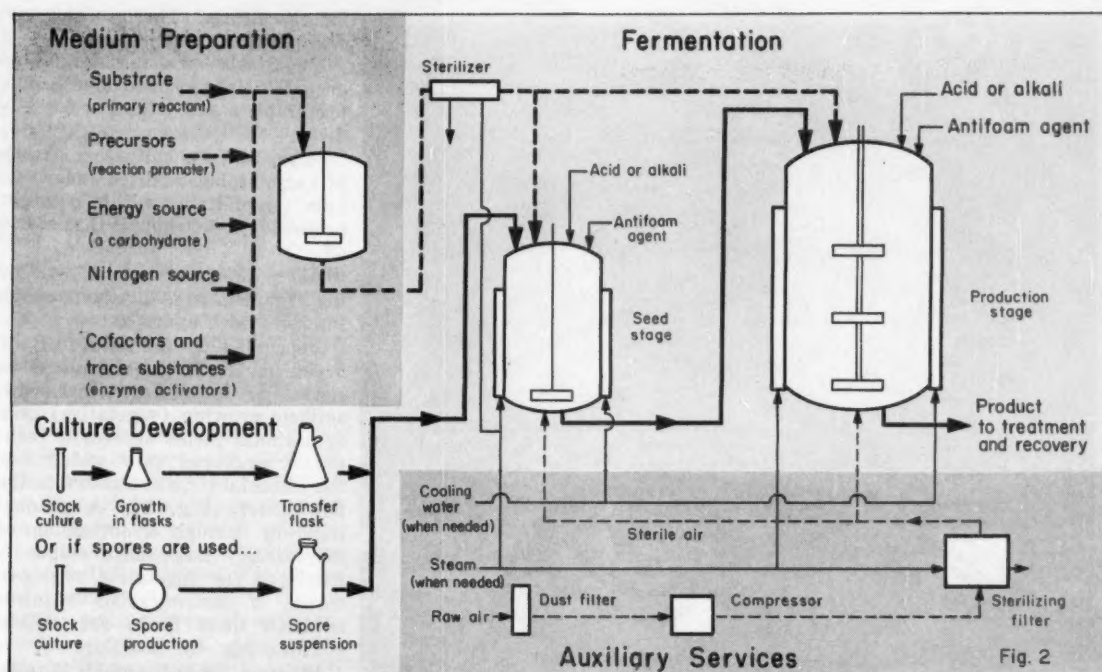


Fig. 2

medium, and accessory lines are all sterilized simultaneously by heating the vessel with steam in coils and jacket. It is usual practice to also inject steam directly into the batch through the fermenter air inlet, the extra water being accounted for in the initial dilution. The air supply line and filter are then simultaneously sterilized.

As we have seen, batch sterilization conditions may vary considerably with the process but a temperature of about 250F. for 20-60 min. is quite common. For the medium of Fig. 3, 17.5 min. at 250F. should be adequate. But some factor of safety is always allowed and 20 to 30 min. would probably be specified.

A typical batch sterilization cycle (heating and cooling for a nominal 20 min., 250F. treatment) is shown in Fig. 4. The medium at 50F. is heated to sterilizing temperature and held for 20 min. after which it is cooled to the process temperature of 85F.

Of course there is considerable heating of the medium during the portions of the cycle before and after the nominal temperature is attained, indicated by the shaded portions of the figure. This excess

heating may be very damaging to a heat-sensitive medium. Furthermore, it increases greatly with vessel size for any given nominal treatment. Whatever its effect, however, it is rarely taken into account in commercial practice.

Continuous Sterilization

An alternative and more favorable scheme is continuous sterilization.

Here the medium, usually in more concentrated form than is finally desired, is rapidly heated while flowing through a heat exchanger and retention tube arrangement designed to give sufficient time for sterilization. A typical arrangement for continuous sterilization is shown in Fig. 5.

The raw medium is pumped through a preheater (heat exchanger), where it cools the sterile medium at the same time, and on to a mixer assembly. Here direct steam injection is employed to achieve the almost instantaneous temperature rise desired as well as to reduce fouling of the heat transfer surfaces. The retention tube serves to hold the medium at sterilization temperature for the required time. It may be jacketed and heated

externally by steam or merely well insulated to prevent significant heat loss.

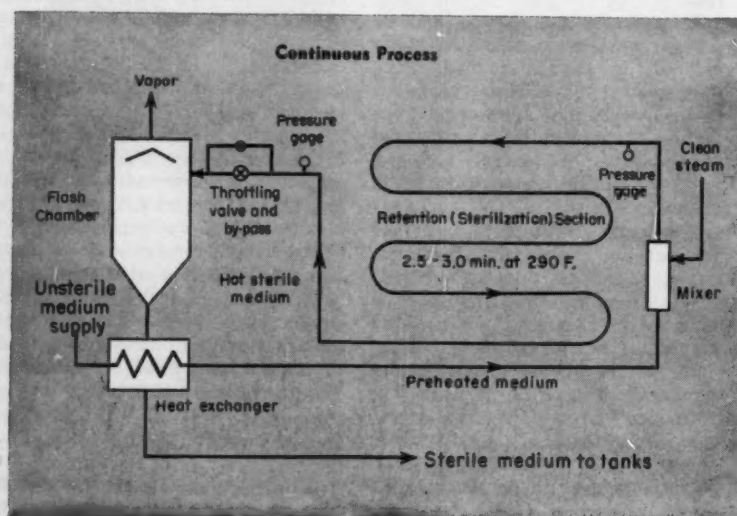
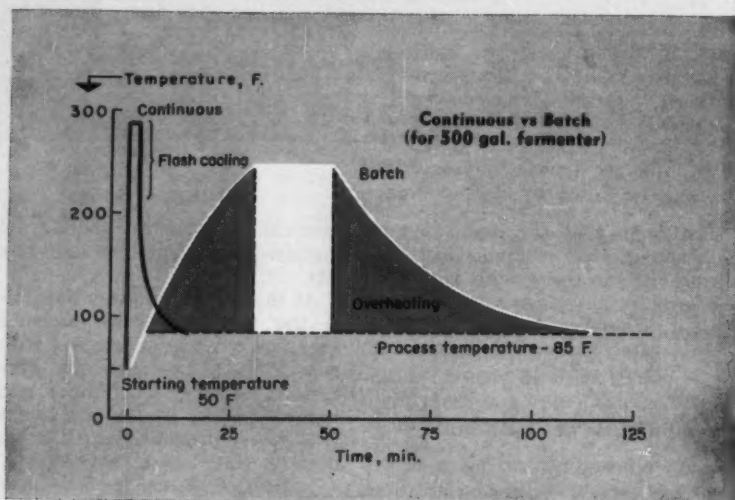
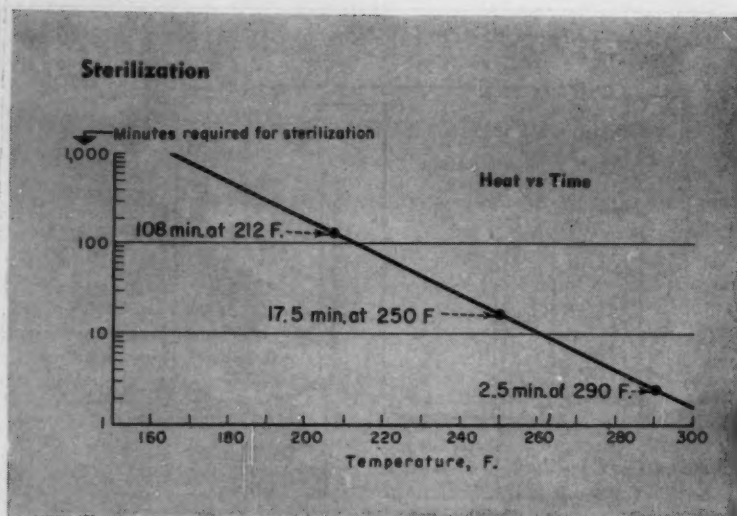
At the end of the retention tube is the throttling valve assembly (for fast cooling). Some cool without flashing in order to avoid the evaporation loss. Either way, though, further heat exchange surface is required to bring the medium to process temperature.

A typical continuous sterilization might employ a nominal treatment of 3.0 min. at 290F., allowing a safety factor over the 2.5 min. called for in Fig. 3. The time-temperature relationship for such a cycle is also shown in Fig. 4 for comparison with the batch method. When continuous sterilization is employed, it is necessary to sterilize the fermenter and any extra dilution water required separately.

Higher temperatures and shorter times are possible with continuous sterilization. Local burning and overheating are minimized and generally better results obtained. The trend is certainly in this direction in commercial practice.

Culture Development

Microorganisms are maintained for use in some kind of laboratory



"stock culture." These include several physical forms.

Soil Stocks—a suspension of the organism is added to sterile soil, preferably a sandy type, and gently dried.

"Lyophils"—a culture is frozen in a small tube and dried under vacuum (lyophilized) within a larger protecting tube which is then sealed off.

Agar Slants—active growth of the organism on a suitable medium solidified with agar.

Depending on the nature of the organism, the fermentation may be seeded or inoculated either with actively growing (vegetative) cells or dormant forms (spores). Techniques employed vary widely but the essential steps are shown in the flow sheet (Fig. 2). A gradual build-up through a succession of increasingly large flask stages is employed for vegetative seed cultures. If the organism requires aeration these flasks are shaken continuously by machine.

Where a spore inoculum is to be used, the accumulation of a sufficiently large number of spores is a primary concern. This is accomplished by preparing "spore bottles," vessels in which the organism is grown over large surfaces of a medium specially designed to induce spore formation. When sufficiently developed, these spores are washed free of the surface and suspended in sterile water or buffer solution. All these operations must be conducted most carefully to avoid any contamination of the cultures with foreign organisms. Vegetative seed cultures are, of course, thoroughly checked before use in the plant.

Transfer of the laboratory seed culture into a large fermentation vessel may be accomplished in any one of several ways. For vegetative cultures, the simplest method is to provide the final flask stage with some kind of hose and coupling, previously sterilized and sealed from the air. The mate to this unit is fitted to the tank and sterilized along with it. At the appropriate time these couplings can be uncovered and joined.

To ensure freedom from contamination the coupling may be loosely made before tank sterilization is complete and steam permitted to bleed through it. Chemical disinfection or flaming are also employed.

Spore suspensions may be han-

dled in much the same way. Another technique preferred by some is to fit the plant seed tanks with a special rubber diaphragm through which the spore suspension may be injected with a coarse hypodermic needle.

Seed (Inoculum) Stage

The initial fermentation stage serves primarily to develop a vigorously growing seed or inoculum for the final production stage. In other words the seed stage represents a primary phase of catalyst preparation.

In some processes more than one seed tank is used, the inoculum being built up just as it was in the laboratory except on a much larger scale. Seed stages may use the same medium as the production phase or different ones. Precursors and specific reactants are, of course, omitted since conversion and synthesis are not sought. In general, seed media are selected to encourage rapid and vigorous growth of the microorganism.

As a rule plant inoculum stages will run from 12 to 36 hr., depending on the organism used. It should be noted that this time is not included in the process times given in Table I. Those values are for the production stage only.

Production Stage

In the production stage, catalyst, reactants, energy source, etc., are combined under conditions selected to give the most rapid conversions or synthesis. Typical operating data for the more important commercial fermentations have been included in Table I.

In some processes it is necessary to add materials to the batch during the production stage. Acids and alkalis for pH control, antifoam agents to prevent excessive foaming of highly aerated batches, and specific reactants like the phenylacetic acid precursors required for benzylpenicillin synthesis are examples. These materials must be separately sterilized, either continuously or in batches, and metered in as required.

Upon completion of the production stage the batch is pumped away for subsequent treatment and recovery. These operations, while essential to the process, are not a part of the fermentation phase itself and will not be considered here.



FERMENTER INTERIOR: Agitator, coils and baffles—Fig. 6.

Fermentation Technology: Engineering Tools

Basic tools are quite adequate as they stand. They don't have to be fancier. Auxiliary equipment should be, but isn't.

A sharp contrast exists between the old and new in fermentation equipment.

Earlier in this report we noted the transition from the old, anaerobic, semi-pure culture processes for solvent manufacture to modern aerobic, strictly pure culture operation for specific conversions and biosynthesis. This fundamental change has, of course, been reflected in the design of fermentation vessels and auxiliaries.

The old solvent fermentations (ethanol, butanol) once seeded or "set" were left undisturbed until completion. Only temperature was controlled during the fermentation proper, and this only roughly.

Heat of reaction was permitted to push the temperature upward as the fermentation proceeded. An upper limit was imposed either by spraying the vessels with water or circulating a portion of the mash through external coolers.

Production Fermenter

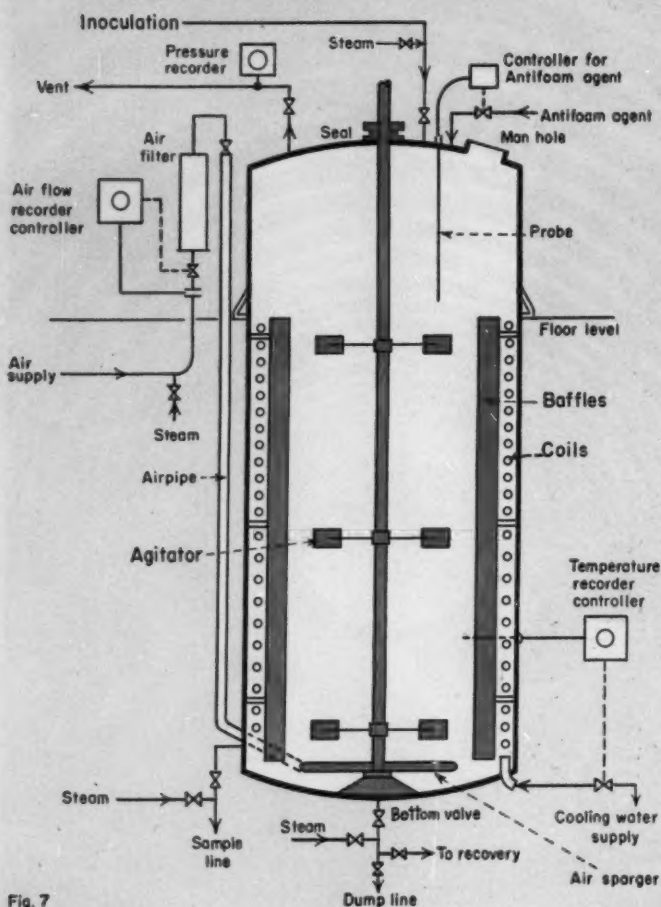


Fig. 7

Other factors like pH were simply established at the start and nature left to take its course.

Solvent fermenters were extremely large—about 50,000 gallons in capacity for the butanol-acetone process and from 100,000 to 250,000 for alcohol. Aeration was not required and the only agitation provided was that brought about by escaping fermentation gases. Since pressure sterilization was not used, construction of these very large vessels presented no problem. The fermenter was, in other words, simply a large tank with accessory piping.

One feature common to fermenters of this type was a collection and recovery system for the valuable fermentation gases, chiefly

CO₂ and H₂. Copper and mild steel were the usual materials of construction.

The past tense has been used here, even though solvent fermentations are still in commercial operation, because no significant addition to plant capacity has been reported since 1945.

Modern Equipment

The workhorse of modern fermentation practice is a different beast indeed. It must provide for the high aeration, thorough agitation, close control of process variables, and complete elimination of contaminants required.

Despite the extreme atmosphere of competitive secrecy which envel-

ops the fermentation industry, particularly its pharmaceutical branch, equipment is amazingly standard. This stems in part from the fact that most major producers of antibiotics and related materials got their start under the more or less cooperative arrangements of the government's wartime penicillin program.

An even more important point, however little recognized, is that the equipment now in use meets the requirements of a great variety of processes rather well. In other words, should we start from scratch to design fermentation equipment, we would end up with very nearly what we have now so far as the individual reactor unit itself goes.

It is in the over-all plant layout and the design of vital auxiliary and control equipment that improvements are most necessary.

Propagators

One type of fermentation equipment may be said to have bridged the gap between old and new. This is the "propagator," a vessel employed for the production (growth) of microorganisms themselves. Baker's yeast, of course, is the cardinal example. But a fair sprinkling of processes exist in which the tissue of an organism—or a substance immediately associated with it—is the primary product.

While fermenters of this sort have certainly been improved in many details, they differ little in basic design from those of earlier times. They are generally simple, with provision for reasonably precise temperature control and abundant aeration, but without mechanical agitation.

Propagators are frequently built with a larger height-to-diameter ratio than mechanically stirred fermenters. This is presumably to provide greater residence time for the air.

Fermenters

The fermenter, as primary reactor, is the heart of any process scheme (Fig. 2). In over-all design characteristics it is closely akin to the general line of batch reactors, autoclaves, and kettles used throughout the chemical process industries.

Fermenters now in use vary considerably in size and materials of

construction but some reasonable generalizations are possible. These are briefly summarized in Table II.

The size of production fermenters depends largely on the manufacturing operations anticipated. For large scale production of bulk antibiotics and feed supplements—penicillin, tetracyclines, cobalamin, for example—larger vessels (15-25,000 gallons) in multiple units (10-50) are used. On the other hand companies whose business centers more on many specialty products, each with a relatively small market, may prefer vessels in the 5,000 gallon range.

A typical production tank with its more important auxiliaries is shown in Fig. 7. (Seed vessels are essentially the same except for their smaller size and the absence of certain accessory units.) Internal construction details are shown rather clearly in Fig. 6.

Materials of Construction—Stainless steels are the usual materials for fermentation vessels but a fair number of carbon steel units exist about the industry. In the main these are older units installed when the first large-scale penicillin operations were undertaken about 10 years ago. They may still be satisfactory for many process requirements, penicillin for instance, but the tendency is to use them more as "batching" (mixing of ingredients) and holding tanks rather than as reaction vessels.

Several companies have investigated the applicability of various chemical coatings such as Heresite to permit wider use of carbon steel tanks, but no general practice can be recognized.

One manufacturer (Parke-Davis) selected Inconel for its chloramphenicol (chloromycetin) plant (Fig. 6) although the claimed

advantages of this more expensive alloy over stainless steel for this use are questionable.

Shell—The tank itself is a tall cylinder, conventionally designed, with a height-diameter ratio in the range 2-3 to 1. Operating volume is usually about 75% of total capacity to allow some headroom for foam build-up. Mechanically agitated tanks are all fully baffled as shown. Both coils and jackets are used for heating and process temperature control, with coils preferred in the larger tank sizes. Sometimes both are present.

Agitation—This is most commonly provided by some type of turbine impeller, mounted singly or in multiples on a central shaft. In larger vessels a bottom, or "step," bearing is required at the bottom to support and align the agitator shaft. The shaft enters the vessel through a stuffing box or rotating seal.

Aeration—Air, at 25-50 psi., is admitted through an external sterilizing filter, air-pipe, and sparger. Sparging devices of many types—all the way from porous ceramics and perforated metal discs, giving clouds of small bubbles, to simple open pipes—have been studied. The tendency toward "cleaner" design has, however, favored the plain circular ring with holes drilled at intervals, and similarly simple arrangements. High-velocity nozzles have been used for aeration in propagators with considerable success but they have not been used to any extent in mechanically agitated vessels.

Controls—A variety of control devices commonly employed in fermentation operations are also shown schematically in Fig. 7. They include: (a) Air pressure and flow recorder-controller; (b) Tem-

perature (cooling water) recorder-controller; (c) Tank pressure recorder (on the vent line); (d) Antifoam addition-controller.

Other important items are the vent, inoculation, and sample lines. Each operator has his own particular scheme for arranging these, the details being adapted to the over-all equipment set-up. One common feature is the presence of steam lines, constantly bleeding live steam over the fittings when they are not in use.

Fittings, Piping, Accessories

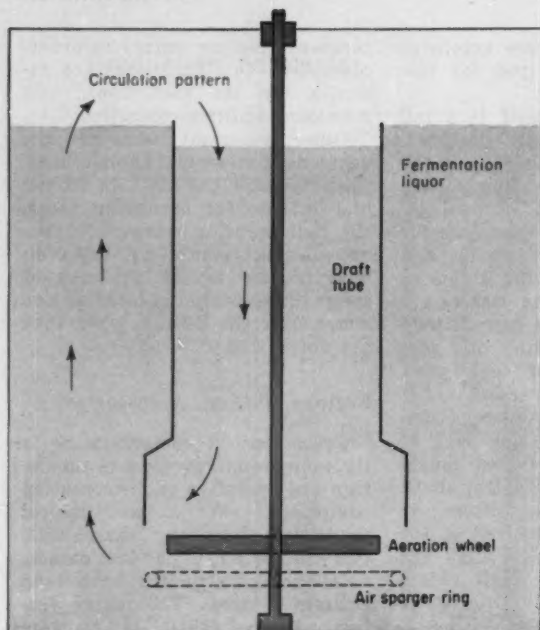
Prevention of contamination is the ever-present problem in the design and operation of fermentation equipment. While no radical changes in fermenter characteristics have arisen in the last decade, details of construction have been entirely revised. The major features of vessel fabrication and piping assembly which are now quite well established are listed below:

Welded Connections Throughout—Screwed and flanged connections have been pretty well eliminated, with welded and polished connections preferred. Internal welds in tanks are also polished to eliminate pits and jagged edges where material can accumulate.

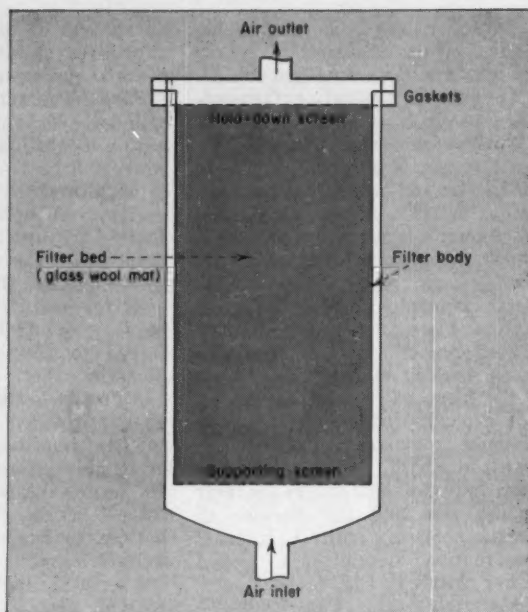
External Fittings Minimized—Nipples and connections to the outside of tanks often provide contamination pockets. They may, because of their particular configuration, be able to lose heat rapidly enough during sterilization to remain significantly cooler than the nominal batch temperature. This may result in incomplete sterilization since certain bacterial spores can survive quite extreme temperatures for considerable periods (Fig. 3). Thus the absolutely es-

Fermentation Equipment Survey: Uses, Sizes, Power—Table II

Type	Uses	Operating Capacity, Gal.	Agitation	Aeration
Seed (inoculum) fermenters	General; antibiotics, vitamins, organic acids	50-1,500	Single or double, flat and curved blade turbines, 0.1 to 0.7 hp./100 gal.	Sparger rings or pipes 1-4 ft./min. superficial velocity
Production fermenters	General; antibiotics, vitamins, organic acids	5,000-25,000	Multiple flat and curved blade turbines, 0.2-1 hp./100 gal.	Sparger rings or pipes 2-6 ft./min. superficial velocity
Waldhof fermenter	Yeast propagation	40,000 as 50-50 air-liquid emulsion	Single "aeration" wheel of special design, 1 hp./100 gal.	Aeration-wheel and draft tube; fermenter operates with medium in air-liquid emulsion state.
Propagators	Yeast propagation; vitamins, enzymes	5,000-15,000	None	Very high air rates used; Spargers, porous stone, nozzles, and various fine-bubble producers. 1-10 ft./min. superficial velocity.
Solvent fermenters	Ethanol, butanol, acetone	50,000-250,000	None	None



WALDHOF fermenter's draft tube whips up froth—Fig. 8.



AIR STERILIZER: Simple setup with big job—Fig. 9.

sential fittings are kept small and close to the tank body; they may also be fitted with external steam bleeders (Fig. 7).

Diaphragm Valves Preferred—Although particular preferences differ, the Saunders-type diaphragm valve with its pinch-clamp action has been widely adopted for fermentation vessels and associated piping. It appears to offer a better guarantee against contamination than the globe and gate types formerly used. The main problem here is the short life of most diaphragm materials under conditions of intermittent heating and cooling.

Rotating Seals—The stuffing-box around the agitator shaft has been a contamination headache in fermenter operation. Recently much improved rotating seals have become available and are rapidly replacing packed fittings. These seals are much smaller, simpler in construction, and appear to offer much more positive contamination protection.

The Waldhof Fermenter

A novel fermenter, developed in Germany during World War II, has found limited application in this country. It is the Waldhof type (Table II and Fig. 8) intended primarily for yeast propagation.

The essential feature of this fer-

menter is a draft tube-agitator assembly which promotes rapid internal circulation of the medium. Its purpose is to provide very high aeration. These fermenters are generally operated with the contents held in a gas-liquid emulsion or foam. Recirculation down the tube causes the foam to continually break and reform.

In the original design air was provided through the agitator shaft and impeller, which was hollow and had openings of some sort around the periphery. An installation of this type is used at the new plant of the Lake States Yeast Corp., where food yeast is grown in sulfite waste liquor.

Although tested for use in other fermentation processes, such as penicillin production, the Waldhof-type fermenter has apparently not found application anywhere outside of yeast production.

Process Control

For a long time process control in fermentation operations signified little more than keeping the temperature within reasonable bounds. Although this situation has improved a good deal, there is still a long way to go. Control over mechanical factors, such as aeration (air flow) and foaming are now fairly well standardized. Of the

variables other than temperature which directly effect the reaction system—pH, reactant and product concentration, etc.—little has been done commercially.

The foaming of highly aerated fermentation batches is a serious problem. Not only does foaming limit the air rates which can be used, but it also causes both deposition of the organism on the upper walls and cover of the reactor, where it does little good, and actual mechanical loss of batch out the vent.

Foaming is sometimes controlled by the periodic manual addition of agents like lard oil, fatty alcohols and others, always sterilized. This operation, however, is time consuming and subject to great variation, depending entirely on the judgment and alertness of the operator.

Others prefer instead to add the anti-foam regularly, regardless of need, by some mechanical system. This may result in excessive "oiling" of a batch causing reduced productivity and subsequent recovery problems.

More recently, automatic anti-foam systems have become quite common, permitting a reduction in labor and more uniform foam control.

These arrangements all use some type of insulated probe (see Fig.

7) extending down to an allowable foam level in the tank. The other terminal of the electrical system is in the tank itself, normally grounded. When foam reaches the probe, a relay circuit is energized immediately or after a short delay to minimize false alarms, and anti-foam addition begins.

Addition may be stopped after a finite period, after which the control circuit is de-energized for a while to permit existing foam to collapse. Alternatively, it may be made to cease when the foam falls to the level of a second probe lower in the tank.

Control of pH, although practiced regularly in the laboratory, has not been successfully applied to any degree in production. In principle the problem is no different from those easily handled elsewhere in chemical processing. The purely mechanical difficulties in maintaining electrodes intact through batch sterilization—insulation failure in glass electrodes and fouling of the reference cell with medium due to momentary pressure differences—have been the stumbling blocks so far. Recent reports suggest, however, that these are being overcome by modified electrode designs.

Attempts at reactant control have been limited to the addition of phenylactic acid precursors and sugar to penicillin fermentations. Actually the word "controlled addition" is wrongly used here; "regulated" is more correct. These additions are not made in response to any signal or variable in the batch, but rather on a prearranged schedule according to the average rate of consumption observed at various times in a large number of test batches.

Air Sterilization

If contamination is to be prevented, the large amounts of air required for aeration must be previously sterilized. Various methods have been proposed but only one is widely used. Air is cleaned in initial dust filters, compressed and filtered through beds of fibrous substances like glasswool and cotton, or particles like activated carbon (Fig. 9).

Until very recently the design of these filters consisted largely of extrapolation from existing units whose performance had been found

satisfactory. And it is fair to say that air filters, despite the immense size of some units, were one of the weakest links in the contamination barrier surrounding fermentation batches. Previous prediction of operating characteristics was practically impossible and their performance, even when grossly overdesigned, was erratic and unreliable.

Recent studies of the action of fibrous filters in removing contaminants from air have led to more rational design procedures. These involve four main elements:

- Such filters can never be absolute, can never remove all organisms with certainty. As long as the holes, or interstices, between fibers (or particles, in the case of carbon) are larger than the contaminants, there is a chance that some of the latter will pass. Hence the design must be based on a reasonable probability of removing all organisms.

- The penetration of such filters by contaminants is logarithmic. In other words the log of the ratio of organisms leaving to those enter-

ing is inversely proportional to the filter bed thickness.

- Proportionality constant in this "log-penetration" relation is a function of air velocity, among other things; so is the pressure-drop. Hence, for any particular filter requirement, it is possible to specify a number of air velocity-filter thickness combinations which will do the job. The most economical of these can then be selected.

- Filter beds which are poorly made up and held in place are more frequent causes of unsatisfactory operation than inadequacies in bed depth. Improved bed materials and mechanical design offer the best solution to this problem.

These principles have now been successfully applied in a number of installations with a great decrease in filter size and a corresponding improved performance.

A sample sterilizing filter, based on these design points, is shown in Fig. 9. Its bed is made up of many layers of a glasswool mat in which the fibers are fixed by a heat-stable, plastic bonding agent.

A Chemical Process for Chemical Engineers

Fermentation is a complex—but not unfathomable—chemical process. Chemical engineers will profit from more work with it.

We've seen that fermentation is a "special" kind of chemical process only in that it employs a very complex and delicate type of biological catalyst. In addition, the energy relationships involved are unusual and reaction mechanisms are often quite complex and not well understood.

Nevertheless, fermentation processes are identical in principle with the more familiar chemical processes and the basic approaches to design and operation developed elsewhere in chemical technology are just as applicable here.

It follows that the chemical engineer's function in the fermentation business is the same as in other branches of the chemical process industries. In the production end, his role has always been reasonably clear. In development work this is unfortunately not the case.

There the chemical engineer's relation to the research microbiologist and biochemist should be the

same as with chemists in plastics, petroleum and other areas of chemical technology. These people provide the elements of the process: reactants, catalysts, products and essential data on conditions. Given these tools, the development engineer is primarily responsible for designing the process, and the equipment with which to carry it out—in close cooperation with the biochemist and microbiologist, of course.

Equipment aspects of this work have been fairly well handled; some of the more "mechanical" achievements have been summarized in the previous discussion. Process design is another matter, one which badly needs application of techniques found useful elsewhere, particularly in elementary reaction kinetics.

Important problems and achievements in both these areas will be discussed in the following section off the report.

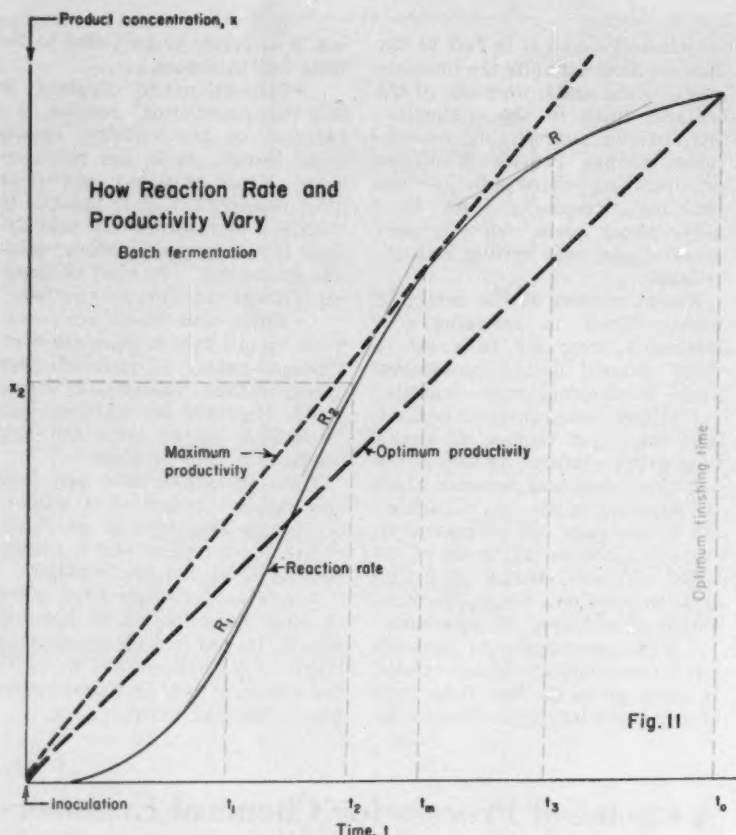


Fig. 11

Fermentation Technology: Design Objectives

Fermentation's big weakness—and chemical engineering's big job—is process design. It hasn't changed much in 50 years.

Aside from the purely mechanical factors in fermenter design, like valves and fittings, the main application of chemical engineering techniques has been in the critical matter of aeration and agitation. The results have been quite beneficial except that they have tended to hide the other important contributions which chemical engineering can make to fermentation, particularly in matters of process design.

The design of fermentation processes, despite some significant improvements in equipment and physical techniques, has advanced very little in the last 50 years. If one compares published reports on the development of early commercial fermentations with recent ones on antibiotics and the like, no sig-

nificant change in approach will be noted. This is probably the greatest factor contributing to the slow development of continuous fermentation methods.

Aeration-Agitation

Since most current fermentation processes are highly aerobic, the provision of an adequate oxygen supply is essential. Penicillin fermentation may, for example, require as much as a gram of oxygen per liter per hour. This oxygen is generally supplied by aeration in the presence of mechanical agitation.

Yeast propagation, one of the oldest commercial fermentation processes, also requires vigorous aeration so this problem did not

arise so recently. In fact a great deal of technological know-how had accumulated by 1945.

Yeast growth presents a rather simple problem, however, in that the microorganism is small and grows diffusely through the broth causing little change in its fluid properties. It has been found that adequate aeration can be attained by simply blowing enough air, finely dispersed by some sparging device, through the broth.

In the antibiotic processes a different behavior is found. Growth is extremely heavy, causing the medium to become an extremely viscous sludge. Under these conditions aeration alone is not sufficient to ensure maximum productivity and a substantial amount of mechanical agitation is required.

This is clearly seen in Fig. 10, where the productivity of penicillin batches is related to the mechanical (agitator) power input per unit volume and the superficial air velocity or aeration rate.

Investigations of this type showed many production fermenters to be seriously underpowered for certain process requirements, penicillin being the prime example. Early agitated fermenters, constructed under the wartime penicillin program, were often equipped to deliver only 0.2 to 0.3 hp. per 100 gal. of aerated broth. This is quite inadequate (Fig. 10) for maximum penicillin production at air velocities of 2 ft./min. A 4 ft./min. air rate is more nearly adequate but still falls short.

As a result of this work newer production fermenters are designed to provide 0.8 to 1 hp. per 100 gal. At the same time older units in most plants have been repowered to reach these levels.

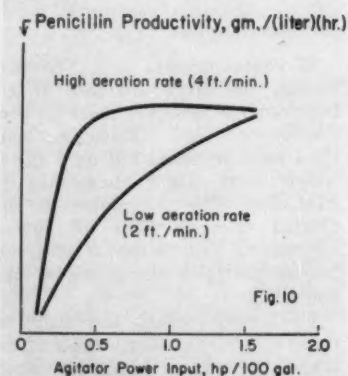


Fig. 10

Some fermentation systems like streptomycin biosynthesis appear to be much less sensitive to aeration-agitation effects than is penicillin production. At present, there is no way of predicting these relationships in advance, so a study of aeration-agitation requirements is now considered to be an essential part of fermentation process development.

Yield and Productivity

In fermentations of the conversion type (the oxidation-reduction systems of Fig. 1 and Table 1) it is quite possible to quote yields in the conventional manner. They may be expressed as "% theoretical," where the stoichiometric amount of product equivalent to a unit mass of starting carbohydrate is used as the standard. Gluconic, citric, and itaconic acid, as well as alcohol and other solvent yields, can be reported this way.

More commonly, however, conversion yields are reported in ratios to the amount of carbohydrate utilized. Product formed per weight of sugar used is common (citric and itaconic acids, etc.) but occasionally an old industry has its own special terminology. An example is the "proof gallons per bushel" employed in the production of ethanol from grains.

In the case of biosynthesis, more often than not there is no stoichiometric basis for expressing yields. Since we do not know the nature and quantities of reactants required to form a product like penicillin, streptomycin, or cobalamin, we cannot compute "% yield" or conversion. The usual practice in these processes is to simply express the final concentration or "titre" of product in the medium and the time required to reach it (see Table 1).

More recently a more consistent and useful value, "productivity," has been introduced to express the results of complex biosynthesis and other reaction systems on a common basis. Productivity is simply the average rate of product formation over any period of time. In a batch fermentation it is the concentration (mass/unit volume) at any point divided by the elapsed time, as shown in Figure 11.

Note that the maximum productivity, P_{max} , for a batch process is given by the tangent to the product concentration curve. This could be obtained by finishing the batch at

time, t_{max} . However, stopping the fermentation at the point of maximum productivity often results in poor utilization of raw materials and low conversions. Hence it is advisable to run the batch longer to some time, t_{final} , where over-all economy is better.

The instantaneous rate of formation or production, R , indicated by the slopes of the product

formation curves, is a reaction rate and varies throughout. The rate R , at time t , is roughly the maximum and occurs considerably before maximum productivity is attained. Although productivity (P) and reaction rate (R) at any point in the batch cycle are different, they are both expressed in units of concentration (mass/volume) per unit time.

Concentration

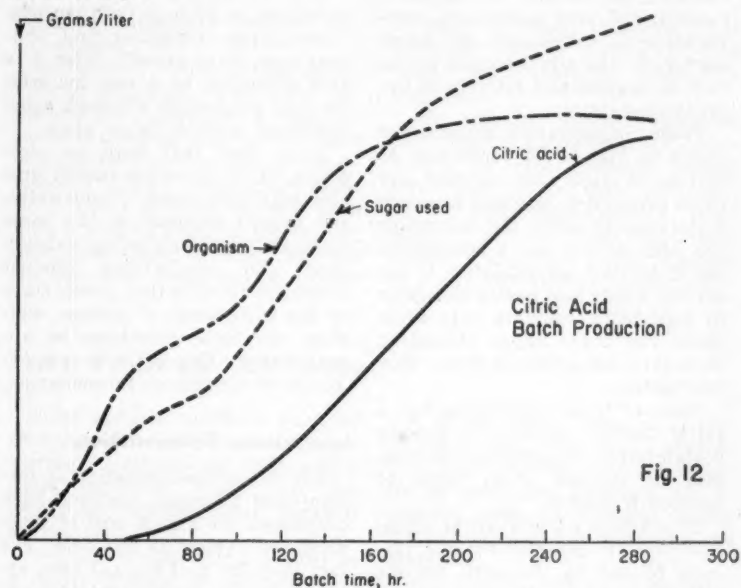


Fig. 12

Reaction Rate

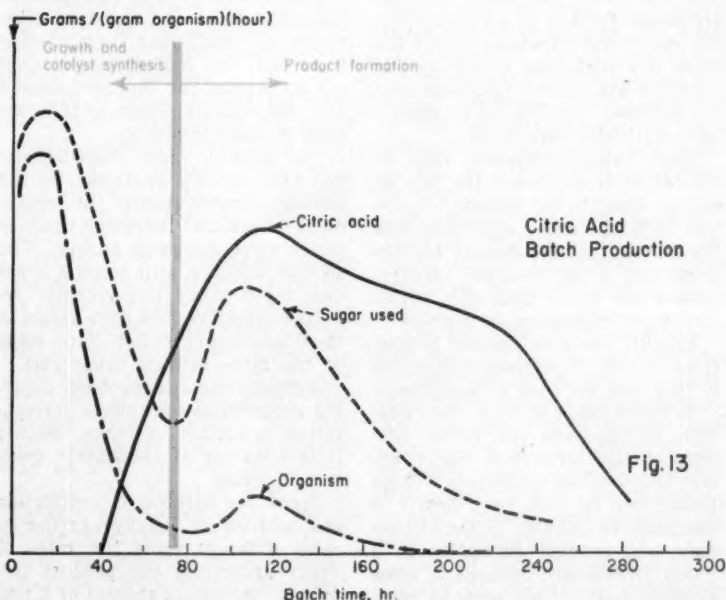


Fig. 13

In the rare case of a product concentration-time curve which is linear and goes through the origin (no lag in product formation at the start-up), productivity and reaction rates are identical.

Batch Fermentation

Since batch operation is an unsteady state process, concentrations of reactants and products are changing throughout. In addition a further, and very significant, complication is introduced, as noted earlier, by the simultaneous variation in amount and activity of the organism-catalyst.

These concentration changes are shown in Fig. 12 for conversion of sucrose to citric acid. Growth and rapid production of tissue proceeds quite rapidly after the fermenter has been seeded but a substantial lag in product accumulation is observed. Citric acid begins to appear in significant amounts only after about two days. Sugar utilization is, in turn, a function of these other two factors.

Each of these phenomena has a fairly distinct meaning in process design terms. Growth, for example, may be thought of in terms of catalyst formation.

Of course it's true that the actual catalysts are complex enzyme systems formed by the cells, not the cells themselves. Hence measurement of the accumulation of cells does not mean that these enzymes are being formed at a corresponding rate. Nevertheless, except for those few instances where specific catalysts are known (gluconic acid for example—see Fig. 1) we simply have no better indication.

Next, sugar utilization may be considered to represent the rate of energy input to the system. It also may be only a crude approximation for many other substances besides sugar are being oxidized. Nevertheless we again lack any better method of expression in practice.

Finally, there is product formation, the key to process design. It is this that we wish to maximize.

In batch processes it is often possible to recognize two rather distinct phases—growth of the organism and product formation. These phases can be seen very clearly if the rates of growth, sugar utilization, and product formation in a batch process are brought to some common basis. Unit mass of cata-

lyst would be the ideal one but, since we cannot determine this, we must settle for the less specific unit mass of organism.

Patterns for these three essential rate processes—growth (catalyst formation), sugar oxidation (energy input) and product formation—in citric acid production are also pictured in Fig. 13. On this basis the two phases of the process are quite evident.

In citric acid production sugar utilization is high in both periods. Carbohydrate oxidation first supplies energy for growth; later it is used primarily as a raw material for acid production although some additional growth takes place.

It is clear that here, as elsewhere, batch operation cannot provide maximum rates, productivity, and overall economy at the same point. Only by establishing a steady state and maximizing product formation rates in that steady state by the adjustment of process variables can these objectives be approximated. This is the proper objective of continuous fermentation.

Continuous Fermentation

The continuous operation of fermentation processes has long been considered the logical goal of technical development in this field. The fact that the goal has not been attained to any degree certainly deserves examination.

For a long time (and still in some quarters) the standard comments on continuous fermentation were two: (a) contamination could not be avoided for long periods and (b) the culture would degenerate even if uncontaminated.

The first of these impediments has been largely overcome by the various improvements in equipment design and operating practice which were discussed earlier. The second objection still needs a great deal more study but recently reported investigations have failed to show any degeneration with some of the more delicate organisms.

Actually the real problem delaying commercial continuous fermentation is neither of these. Rather it is a matter of elementary reaction kinetics.

Since the catalyst concentration and activity is usually varying at rates different from the rates of sugar utilization and product formation, the establishment of a pre-

dictable steady state in one vessel from batch data is not possible. Only by using a two-vessel system—one for growth and the other for product formation—with a stable organism concentration can this problem be overcome.

Single-vessel continuous processes have been used for yeast growth but this represents a very special case. Here the product is the organism itself and hence there is really only one rate to be concerned with and only one steady state to establish.

The usual approach in continuous yeast propagators is to use a "batch curve," like Fig. 11, except that yeast itself, is the product. In order to establish a steady state at any point one simply reads off the rate, R , and concentration, X , at that point.

At t_s in Figure 11, for example, the rate of growth would be R_s and the yeast concentration X_s . With no yeast in the feed medium, which is usually the case, the retention time, θ_n , required in the reactor (fermenter) is:

$$\theta_n = X_s/R_s$$

and the required fermenter volume, V_n , is given by:

$$V_n = \theta_n F$$

F is the rate of production, in volume per unit time, of material containing a yeast concentration X_s .

Unfortunately this simple treatment is limited to those cases where growth of an organism—rather than production of a specific chemical—is the primary objective. A great deal more work must be done before an adequate approach to continuous process design for more complex reaction systems is established.

Fermentation "Scale-Up"

Reaction rate studies offer the main approach to process scale-up and, unfortunately, such knowledge is woefully lacking for fermentation systems.

In highly aerobic fermentations oxygen supply often appears to be the most critical process variable. It depends (Fig. 10) on both aeration and agitation. Several systems for measuring this parameter have been proposed.

Other important factors have been generally overlooked. Perhaps the most critical of these is medium sterilization.

Corrosion Testing at High Temperatures

Here are the problems involved in selection of materials for use at high temperatures, testing methods, and—what's most important—the application of test results.

N. D. GREENE, JR., Corrosion Research Laboratory, Ohio State University

Corrosion by liquids at elevated temperatures and pressures is extremely important in this "heat and squeeze" era of chemical engineering technology. Elevated temperature corrosion, or corrosion occurring at temperatures above the boiling point of the liquid medium, has become an increasingly important factor in modern chemical processes. In fact, the feasibility of many processes is dependent only on the successful application of metals and alloys in equipment construction.

In view of these facts, it is surprising that so little information has been published on the subject of corrosion testing at elevated temperatures. Although corrosion testing at boiling temperatures and below is commonplace in many plants, testing under conditions of extreme heat and

pressure introduces special considerations.

Since there is no simple, standardized procedure to evaluate materials for corrosive service at elevated temperatures, we will start off by examining the basic problems involved in high temperature tests. With these in mind we will then take a look at some of the testing techniques used. Finally, we will see how test results can be applied

to plant corrosion problems. This sequence should provide a firm basis for a corrosion evaluation program.

We will not discuss specimen preparation, corrosion rate calculations, or other general testing techniques since they are adequately described elsewhere.^{1,2} An excellent review of the basic techniques of corrosion testing appears in a series of articles by Fontana.³

Four Problems Are Basic

Here are the problems peculiar to elevated temperature corrosion testing. Methods of eliminating these problems depend on the particular specifications imposed on the test.

Container—The test container is a minor problem in ordinary corrosion testing. A beaker or flask is usually sufficient. However, when we operate above the normal boiling point of the corrosive liquid, the container must meet several severe requirements.

First, it must be very resistant to many corrosive media. We might want to investigate anything from crude oil to fuming nitric acid. This versatility can be possible only if the container is chemically inert.

Attack of the containing vessel introduces contaminants into the corrosive solution. This contamination by corrosion products can introduce serious errors, either by inhibiting or accelerating the corrosion of the specimen. For example, the presence of only 0.04% cupric ion in 85% phosphoric acid at 270F. reduces the attack on cast 18-8 stainless steel from 10,000 to 10 mils per year, a factor of one thousand.

The container must also withstand the high pressure developed during testing. This pressure is

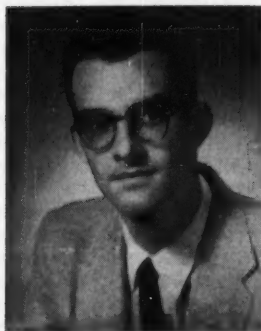
due to the vapor pressure of the corrosive and the gaseous corrosion products resulting from the attack on the specimen. Pressure due to gaseous corrosion products should not be overlooked in designing the container.

It is best to work up to temperature when evaluating a material in a new corrosive. That is, a few tests should be made at temperatures below the desired one. From these tests, it can be determined if the pressure due to gaseous corrosion products will be excessive at the desired temperature. Such precautions will avoid the possibility of dangerous container failures.

A maximum working pressure of 1,000 psi. should be sufficient for most tests. This pressure corresponds to a temperature of 540F. for water.

The necessary chemical inertness and strength of the container can be achieved by several methods. Most obvious choice is an autoclave. An autoclave should permit easy introduction and removal of the specimen and solution. Closely fitting parts should be avoided to prevent fouling and seizure because of corrosion.

Cost of the autoclaves can be reduced by the use of corrosion-resistant lining material. The body



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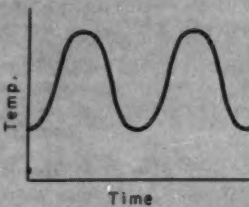
How Corrosion Rates Go Wrong

By Error in Temperature Measurement . . .

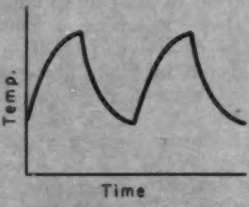
Temperatures, Deg. F.		Corrosion Rates	
Observed	Actual	Mpy.	Error
300	300	20.0	0.0%
300	301	20.7	3.5
300	302	21.5	7.5
300	303	22.2	11.0
300	304	23.0	15.0
300	305	23.8	19.0
300	310	28.3	41.5
300	315	33.7	68.5
300	320	40.0	100.0

By Thermal Cycling . . .

Sinusoidal Cycle

	Amplitude	Corrosion Rates	
	Deg. F.	Mpy.	Error
	0	20.0	0.0%
	5	20.0	0.0
	10	20.1	0.5
	20	20.7	3.5
	40	23.4	17.0
	60	25.0	25.0
	80	31.4	57.0
	100	36.0	80.0

Saw-Tooth Cycle

	Amplitude	Corrosion Rates	
	Deg. F.	Mpy.	Error
	0	20.0	0.0%
	5	20.3	1.5
	10	21.1	5.5
	20	23.2	16.0
	40	28.5	42.5
	60	31.0	55.0
	80	44.0	120.0
	100	55.5	178.0

All data: 18-8 stainless steel in 20% nitric acid.

The table shows the errors introduced into observed corrosion rates caused by inaccuracies in temperature measurement. An error of only five degrees results in a 20% error in the corrosion rate.

This temperature dependence of corrosion reactions can also introduce error if thermal cycling is present. This error arises if the mean temperature is assumed to be the average of the maximum and the minimum temperature of the cycle. Corrosion rate is a logarithmic function of temperature. Hence a simple average does not give the correct answer.

The table illustrates the magnitude of the error due to thermal cycling. Saw-tooth curves are a familiar phenomenon occurring in poorly-insulated thermal systems operating near maximum temperature. The corrosion rates were determined by graphical integration.

How can these inaccuracies be avoided? The first step is to use accurate temperature measuring devices. Calibrated thermometers or thermocouples should always be used. Standard grade laboratory thermometers are quite often erroneous over a wide region of their scales.

Accurate temperature measurement is difficult because the temperature to be measured is relatively inaccessible. Because of pressure considerations, the walls of the container will necessarily be quite thick. Temperature differences between inside and outside can be significant, even when using a thermometer well. A liner with low thermal conductivity, such as plastic or glass, will increase this difference. Direct measurement of internal temperature is almost impossible because of pressure-sealing problems, and because in many cases the corrosive will rapidly destroy thermocouple junctions.

An indirect method of measuring temperature can be employed. Calibration curves of internal versus external temperature can be made by using oil or Dowtherm instead of a corrosive fluid. The low vapor pressure of these substances eliminates the need of pressure sealing during calibration tests up to approximately 400F.

If the test containers are small, say 250 to 500 cc., temperatures within them will be practically

can be fabricated of mild steel or stainless steel and a lining of platinum, tantalum, gold or other inert metal used. Teflon liners and glassed steel have also been used successfully at temperatures up to 400F. These two materials are probably the least expensive lining materials.

Thick-walled glass tubes have also been used as containers for elevated temperature tests. These will be discussed later.

Temperature—Measurement and

control of temperature are the most important factors in elevated-temperature corrosion testing.

Let us examine the effect of temperature on corrosion rate. The rate of corrosion reactions, like other chemical reactions, is approximately doubled for every 20F. increase in temperature. Although there are exceptions to this rule of thumb, it applies to many corroding systems.

What, then, does this mean in terms of experimental accuracy?

uniform. Large containers introduce the possibility of large thermal gradients.

Temperature control must also be very precise to insure accurate results. Thermal cycling should be eliminated or minimized. This can be done by proper design of the temperature control system. The thermostatic control element should be close to the heat source.

For example, suppose we wish to maintain constant temperature within an autoclave that is heated by an oil bath, which in turn is heated by an electric resistance heater. Best spot for the thermostat is in the oil bath. If it is placed in or on the autoclave, it won't be very sensitive to temperature changes of the oil bath. In this case the thermostat is far from the heat source, and the thermal lag of the system will inevitably cause cycling.

On the other hand, placing the thermostat in the oil bath will result in much less cycling because it will sense temperature variations more rapidly.

This problem of cycling can be eliminated by discarding thermostatic controls entirely. This can be accomplished by using a variable power input to the apparatus. An autotransformer coupled to a constant voltage supply source will do the job. Using this method, good insulation of the apparatus is essential.

A continuous temperature recorder should be used to insure that constant temperature is maintained during the testing period. Arcing electrical contacts and night time power shut-offs will go undetected unless a continuous temperature record is made.

Time—Ideally, any corrosion test should have a duration equal to the desired life of the equipment. Corrosion rates are not always constant, as they may increase or decrease depending on the metal and the corrosive environment. In considering plant corrosion problems, it is impractical to wait this long for an answer.

So the short-time corrosion test is used. This type of test may last anywhere from five to several thousand hours. The information from these short-time tests is extrapolated to longer periods by assuming a constant corrosion rate. This is a somewhat crude but very necessary assumption.

Duration of a short-time test depends largely on the corrosive resistance of the material under study. The test should be long enough so that an appreciable weight loss is observed. On the other hand, length of the test should not be so long that the specimen dissolves completely or becomes perforated. Low weight losses or complete solution of the specimen are sources of error in corrosion rate calculations.

An additional problem is introduced in elevated temperature tests. This is the measurement of test duration. Since the test is conducted at pressures above atmospheric, the unit has to be sealed and then heated to the desired temperature. At the conclusion of the test the unit must be cooled before it can be opened. During the heating and cooling periods corrosion of the specimen occurs.

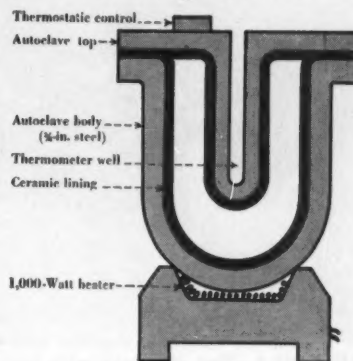
What then is the actual duration of such a test? If we take the total time at the desired temperature as the duration, the calculated corrosion rate will be greater than the actual rate, because of the attack during the heating and cooling periods. If we base the duration on the entire testing period, the corrosion rate will be lower than the actual rate because of the lower temperatures during the heating and cooling periods.

How can this problem be eliminated? If the time at the desired temperature is long compared with the heating and cooling periods, the error will be reduced. The heating and cooling periods can be measured by dummy runs, and the actual tests planned accordingly. Here again, we see another advantage of a small container. The smaller the container, the more rapidly it can be heated and cooled.

When the heating and cooling periods are short compared with the total test duration, the slight error that is present can be further reduced by a simple procedure. The test duration is assumed to be the period between the instant heat is first applied and the moment the cooling period begins. The corrosion occurring during the cooling period is thus added to the corrosion during heating, and a more accurate over-all rate is obtained.

Safety—Any type of corrosion testing is a potentially hazardous operation. Many of the corrosives used are highly injurious to

TEST METHOD 1 How to compound errors



Outstanding disadvantages:

- Poor temperature measurement
- Poor temperature control
- Thermal cycles up to 100°F.
- Liquid gradients up to 50°F.
- Weight: 75 lb.
- Gasket leakage
- No safety measures

humans. Toxic vapors and acid spattering are a few of the potential hazards.

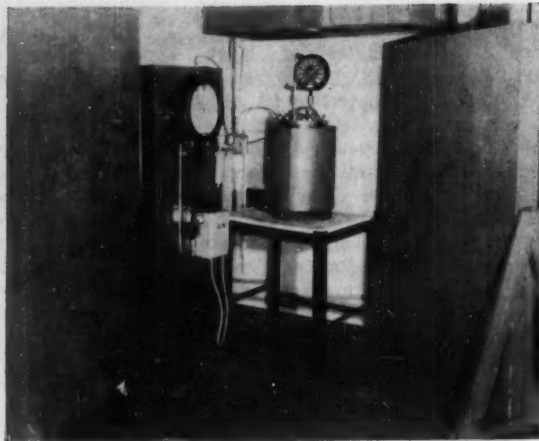
Testing at elevated temperatures and pressures increases the risk of the operation. Possible burns and injuries resulting from container or gasket failures are the most important points to consider.

Dangers of high-temperature corrosion testing can be reduced by isolating the testing area. A special room, barricades, or other devices are often used. Remote controls for temperature and power can also be used.

By completely isolating the testing area, the operator is only present before and after the test. Danger of burns and equipment failure is practically eliminated.

Small test containers, besides aiding temperature control and test duration measurements, will increase the safety of the test. It is obvious that failure of a small container is less dangerous than the failure of a large one.

In planning safety measures, it is best to let your imagination run wild. By imagining the most catastrophic accident possible and designing on this basis, the testing operations should be no more dangerous than other routine laboratory work.



METHOD 2—Test autoclave with replaceable glass liner goes into oil bath, is connected to controls and barricaded.

Three Ways to Test Corrosion Resistance

We have now examined the problems of corrosion testing at elevated temperatures. Let's take a look at the various methods used to evaluate materials under these severe conditions.

Method 1—This method of evaluating corrosion resistance at elevated temperatures was unsuccessfully used by several investigators. It is included because it illustrates the necessity of proper design.

The apparatus is shown on p. 177. A steel autoclave with a corrosion-resistant liner and a capacity of about 1 liter was used. Heating was done by resting the autoclave on an electric resistance heater. Temperature was measured by averaging the readings of a dial thermometer with an accuracy of $\pm 5^\circ\text{F}$.

It is obvious that this design is very poor from the standpoint of temperature measurement and control. When the heater is turned on, heat must pass through the $\frac{1}{2}$ in. of lined steel, through the liquid media, through the vapor phase, and then through another $\frac{1}{2}$ in. of lined steel before the thermostatic switch will sense it. This thermal lag produced tremendous thermal cycles within the unit. Cycles as high as 100°F . were detected. Temperature gradients of 50°F . between the top and bottom of the liquid phase were also observed. The temperature measurement was also in error because of the crude measuring method and the internal thermal fluctuations.

No safety measures, such as barricades or remote control, were used even though a half-dozen autoclaves were operating simultaneously. Fortunately, no serious accidents occurred during the use of this apparatus.

There are numerous other disadvantages such as the fact that the units weighed about 75 lb. each. Manipulation was anything but easy. Gasket leakage often corroded the thermostatic switches during test runs and the temperature ran wild.

Needless to say, this method of testing became obsolete rather rapidly. The effort and money spent in its construction and operation were completely wasted. This example should serve as a reminder to those planning elevated temperature corrosion studies.

Corrosion testing, especially high-temperature tests, requires careful planning. Type of specimens to be used, accuracy desired and a hundred other details must be considered before the testing apparatus and procedure are chosen. Even then, numerous changes will be necessary to iron out bugs that will inevitably be present.

Method 2 — Practically all of the elevated-temperature corrosion studies at The Ohio State University sponsored by the Alloy Casting Institute have been conducted in autoclaves heated by liquid baths. Although many types and sizes of autoclaves were used in these

studies, the basic idea remains the same.

An exploded view of an autoclave utilizing a replaceable glass liner is shown above. Also illustrated is the assembled apparatus with oil bath, temperature controls, fume hood and safety barricades.

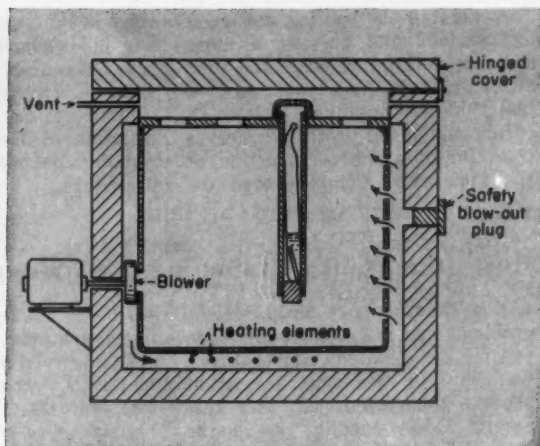
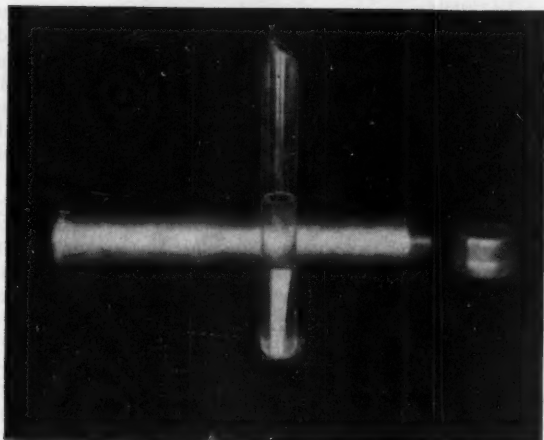
Recent modifications in the apparatus such as Teflon autoclave liners and the use of small autoclaves give this method of testing several advantages. First, the method permits a fairly high ratio of corrosive volume to specimen area with standard sized specimens. Unless a ratio of about 250 cc. of corrosive per square inch of specimen area is maintained, errors due to corrosive depletion or corrosion product contamination may become significant.

Another advantage is that the pressure above the solution under test can be measured and varied. Also, the composition of the atmosphere above the solution can be varied, e.g. by using nitrogen, oxygen, or air.

The method also has the advantage of being safe. The heavy-walled, corrosion-resistant autoclaves and proper barricading have given six years of continuous testing without injury to personnel.

However, the method has disadvantages. The specially-designed units cost money to construct, operate and maintain. The data is expensive. On the other hand, corrosion failures of chemical equipment represent an even costlier method of obtaining data.

Temperature measurement and control of the units is another



METHOD 3—Sample and corrosive in glass are placed in protective sleeve, capped and put into oven for tests.

haunting problem. The heavy-walled containers that permit safe operation make temperature measurement and control very difficult. Dummy runs and calibration curves relieve but do not completely eliminate the problem. Even with these disadvantages, this testing method has proved very satisfactory in evaluating materials for corrosive service at high temperatures.

Method 3—Miller, Treseder, and Wachter describe another method of corrosion testing at high temperatures.⁶ The apparatus is very simple and easy to construct. (See cut of a similar apparatus used at Ohio State.)

The test container used consists of a heavy-walled glass combustion tube in which a small metal specimen and the corrosive medium are sealed. The sealed tube is then in-

serted in the steel protection sleeve shown in the background. These units are then placed in a constant temperature oven as shown. After the test is completed, the combustion tubes are carefully broken open and the specimen is removed.

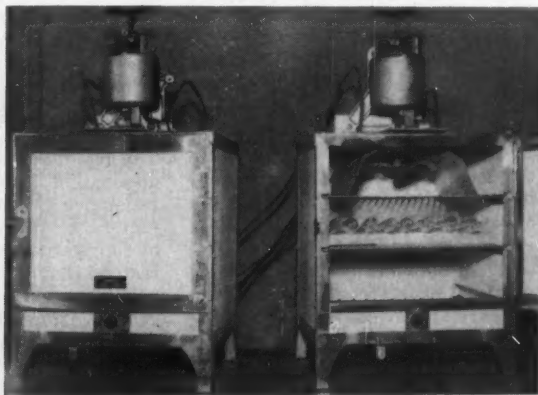
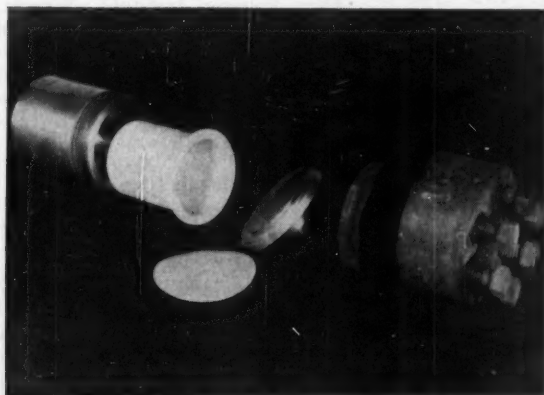
This method offers many advantages. The apparatus can be easily and cheaply constructed. One technician can handle twenty tests per day. Thus, the cost of evaluation data will be low.

The Pyrex brand glass combustion tube is highly resistant to most corrosives. Exceptions are those containing hydroxyl or fluoride ions. Since the test units are completely immersed in the heating oven, the temperature of the tube interior and oven are identical at equilibrium—making temperature measurement easy.

This method also has several disadvantages. For one thing, the low volume—area ratio introduces problems of corrosive depletion and ion contamination. Pressures cannot be measured in the apparatus. Also, the glass tubes present a safety problem. They must be handled with extreme caution during and after the test run. There are never any slow leaks with the tubes. Failure is always quick and violent.

By eliminating the protection sleeves this method can be improved. A typical apparatus with this modification constructed at Ohio State is shown below. The ovens are ordinary laboratory ovens equipped with circulatory fans.

Removal of the protection sleeve increases the rate of heat transfer from the bath to the tube interior.



MODIFICATIONS include 250-cc. Teflon liner for Method 2; a laboratory oven and unprotected tubes for Method 3.

This reduces the heating and cooling periods and permits a more accurate determination of the time at temperature. As a result, shorter test runs are possible.

Removal of the protection sleeves also simplifies the construction of the apparatus. Complex oven de-

signs are not necessary, and almost any small laboratory oven will suffice. Of course, safety precautions must be increased when the protection sleeves are removed. Complete isolation of the testing area and remote controls are a necessary procedure.

material may corrode rapidly even though we have carefully evaluated its resistance. This happens even in the best evaluation programs. By accurate laboratory testing procedures the number and the cost of trials can be reduced but not completely eliminated.

One of the most important testing considerations is often forgotten. That is, the avoidance of over-protection. In dealing with corrosion problems the emphasis is always on the prevention of failures. But what about the equipment that is satisfactorily resisting attack? Is it doing its job too well? One has only to look closely at a modern chemical plant for the answer to these questions. We find stainless steel, Monel and other highly corrosion-resistant materials being used where a material with less resistance would be sufficient.

Highly-resistant materials give excellent service and are often economically practical. But we must look further than the dollar sign that is so important in engineering decisions. We must consider the depletion of mineral resources of our country and of the world. We can afford over-protection today, but what about the future? Already, the supply of many elements used in corrosion-resistant materials is rapidly diminishing.

The misuse of resistant alloys is due to insufficient information about the corrosion resistance of alternative materials. Careful evaluation of information from corrosion tests can provide both economic saving and conservation of essential metals.

ACKNOWLEDGMENT

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REFERENCES

1. H. H. Uhlig, *Corrosion Handbook*, pp. 951-1099, Wiley, New York (1948).
2. M. F. Mueller and A. D. Laehder, *Chem. Eng.*, Oct. 1953, pp. 193-195.
3. M. G. Fontana, *Ind. Eng. Chem.*, 46, 91A (Apr. 1954); 46, 93A (June 1954); 46, 91A (July 1954); 46, 77A (Aug. 1954); 46, 85A (Sept. 1954); 46, 92A (Oct. 1954); 46, 77A (Dec. 1954); 47, 81A (Feb. 1955); 47, 89A (Apr. 1955); 47, 91A (June 1955); 47, 81A (Nov. 1955).
4. F. H. Beck and M. G. Fontana, *Corrosion*, 9, 287-293 (Aug. 1953).
5. R. F. Miller, R. S. Treseder and A. Wachter, *Corrosion*, 10, 7-12 (Jan. 1954).

Most Important: Evaluating Test Results

Now that we have discussed the problems and methods of corrosion testing at elevated temperatures, we come to the most important aspect—application of the test results. Oddly enough, this is the most difficult problem.

Strictly speaking, a corrosion test only evaluates the resistance of a material under the specific conditions of the test. Naturally, we always attempt to reproduce the plant conditions within laboratory test systems. Perfect duplication is practically impossible because of the myriad of unknown and unmeasurable variables within a chemical process. Varying fluid flow, trace impurities, and the human element may have a tremendous effect on the performance of equipment.

This inability to exactly reproduce process conditions causes differences between the corrosion rates determined in the lab and corrosion rates observed in the process equipment. In fact, it is extremely rare for test results to completely correlate with plant corrosion rates.

All right, why bother with laboratory tests if they don't agree with plant data? Why worry about the accuracy of the measurements made during tests if exact correlation with actual performance rarely occurs?

The best answer to these questions is that laboratory corrosion data is analogous to a racing form. It, like the past performances of horses, increases our chance of picking a winner. It is a guide to the correct answer—not an answer in itself. Although this is the age of exact science, there is still a considerable amount of "guestimation" in applying corrosion data to practical ends.

There are several ways of making corrosion tests more reliable. For elevated temperature and pressure tests, a survey of the corrosion rates observed at atmospheric pres-

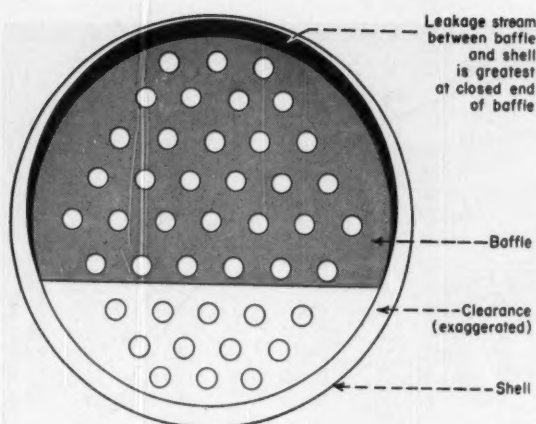
sure will serve as a guide to a likely material. Sometimes, however, the relative resistance of two materials changes at higher temperatures. In any case, the resistance of most materials decreases as temperature increases.

Any metal or alloy showing even the slightest tendency towards localized corrosion should be rejected. Pitting, intergranular attack and other types of localized attack are extremely unpredictable and show very rapid penetration. Attempts to measure the depth of the localized attack are useless.

Let's follow a typical material evaluation procedure. First, the corrosive conditions to which the material will be exposed must be determined. The composition and temperature of the medium and the possible fluctuations in these variables must be known. Next, a literature survey should be made to find metals or alloys with the necessary resistance to the specified conditions. In many instances, especially at elevated temperatures, no corrosion data can be found for the specific corrosive conditions. Extrapolation of corrosion data at lower temperatures, or the corrosion rates in other corrosives of a similar nature, can be used to pick a group of promising materials for laboratory testing. This type of extrapolation should only be used for purposes of screening. It should never be used for final selection.

The next step is a laboratory corrosion test. From this, a tentative choice of material can be made. The best material for the particular application depends not only on its resistance but on a number of other factors. Cost, availability and ease of fabrication are just a few of the factors that must be considered.

Now we have a material that looks feasible. The next step is a trial in a pilot plant or in the plant itself. If the proper considerations have been made, the material will probably do the job. However, the



Shell-side leakage past the baffles can greatly affect your heat exchanger calculations. Here are time-saving charts which will give you correction factors for leakage and help you . . .

Design Heat Exchangers More Exactly

JOSEPH FABREGAS, Alco Products, Inc., Dunkirk, N. Y.

In commercially built heat exchangers, the over-all heat transfer rate is a combined effect of the individual transfer rates: shell fluid, shell fouling, metal tube wall, tube fouling and tube fluid.

Of these individual rates shell fluid is generally controlling and it's the most difficult to accurately calculate. Clearances, necessary to the manufacture and assembly of exchangers, allow fluid to leak past the baffles, affecting the flow of fluid across the heat transfer surface. This leakage can become quite large, depending on the individual manufacturers' tolerances and required clearances, as well as on the final pressure drop.

The "actual" shell fluid pressure drop is very important to the ultimate user. It commonly limits the available heat transfer rate. And since the heat transfer rate and pressure drop are both affected by the leakage effects, in many cases it's important that this effect be approximated as closely as possible for the design condition of the heat exchanger.

Time Saving Procedure

These leakage effects can be calculated but to date no simple method has been presented to do this. In view of this, most heat exchanger manufacturers employ a set of arbitrary multiplying factors which they use for their specific types of construction and which do give reasonable, although at times

extremely safe, values for pressure drop.

We've developed a possible procedure, which partially overcomes the difficulty of time consuming calculation and yet gives a more realistic idea of the true magnitude of the values for actual heat transfer rate and pressure drop in any normal shell and tube, segmentally-baffled heat exchanger. Actually, we've determined correction factors you can apply to the "apparent" or nonleaking calculations. These factors are presented on nomograph charts.

Design Variables

Variables making up the heat transfer and pressure drop calculations can be classified into definite groups including: the type of fluid flow, configuration of the heat transfer surfaces, the characteristics of the fluid and the effect due to leakage.

The type of fluid flow is usually considered as forced convection flow and is divided into two regions. These regions are set so $C_1 D G_s / Z$ is equal to or less than two and where it is larger than two. Here C_1 is a constant for any given tube diameter, pitch and configuration, D is tube diameter, G_s is mass velocity of cross-flow stream and Z is viscosity of the bulk shell liquid.

Common configurations of heat transfer tubes are shown in Table II.

The charts here are based on

normal hydrocarbon oils. But this is not limiting. Actually, the factors from the nomographs are applicable to any fluid, even if the apparent heat transfer rates and pressure drops are calculated by other means than shown here, as long as no inherent leakage factor is involved.

Leakage is directly dependent on the pressure drops causing leakage throughout the heat exchanger system. Usually leakage is obtained by calculating the distribution of fluid flow (leakage, cross-flow, etc.) by trial-and-error—balancing pressure drops over the various flow areas. Eventually, you come up with the leakage flow, but this is a long, tedious calculation.

Here, we've written the simultaneous pressure drop calculations in terms of fractions of total flow and then reduced these to equations approximating quadratic form. Nomograph solution of the equations were graphically adjusted to compensate for the deviation from true quadratic form. The leakage factors, taken from the graph correct the "apparent" calculated values to the actual values.

How to Use Charts

A detailed procedure for the required calculations, using the chart, follows and this will be supplemented with an actual problem:

First determine the following apparent flow areas and mass velocities,

For viscous
flow get F
value here

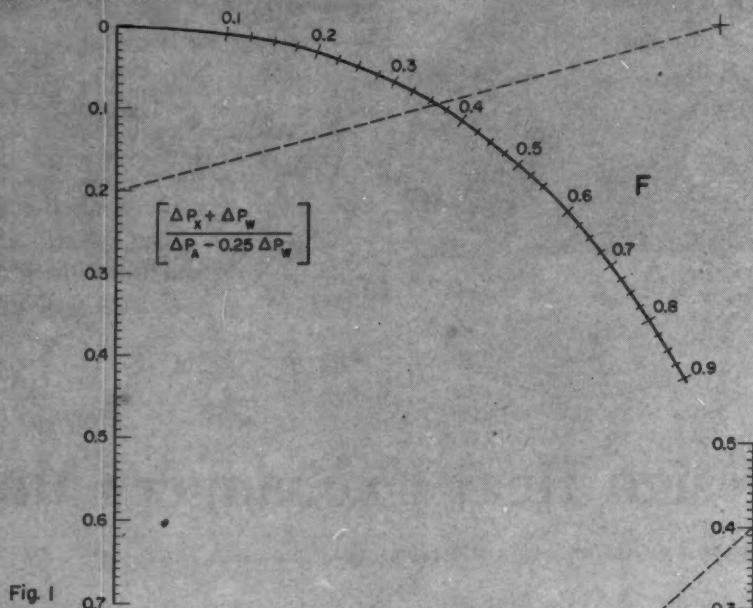


Fig. 1

Scales may be
extrapolated vertically
if required

For turbulent
flow get F
value here

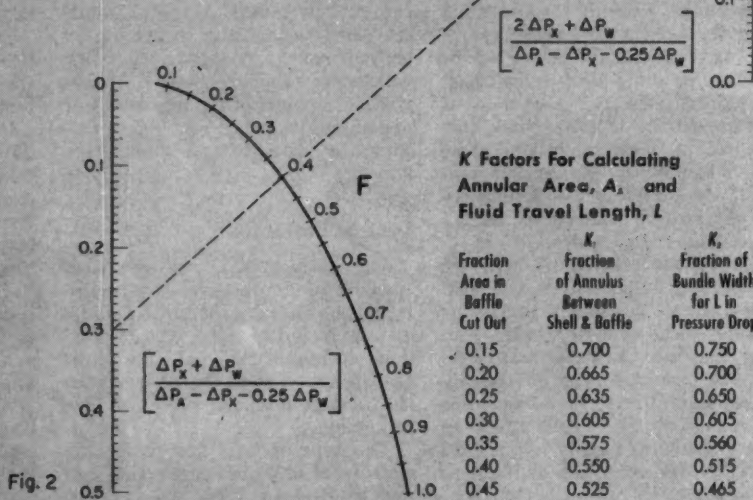


Fig. 2

K Factors For Calculating
Annular Area, A_s , and
Fluid Travel Length, L

Fraction Area in Baffle Cut Out	K_s Fraction of Annulus Between Shell & Baffle	K_L Fraction of Bundle Width for L in Pressure Drop
0.15	0.700	0.750
0.20	0.665	0.700
0.25	0.635	0.650
0.30	0.605	0.605
0.35	0.575	0.560
0.40	0.550	0.515
0.45	0.525	0.465

$G_w = (0.04 W_T) / A_w$ = Mass velocity through
baffle opening.

$G_s = (0.04 W_T) / A_s$ = Mass velocity through
cross flow.

$G_A = (0.04 W_T) / A_A$ = Mass velocity through
leak area.

Determine ΔP_w and ΔP_A

$$\Delta P_w = 0.00000346 \frac{G_w^2}{S}$$

= pressure drop through baffle
opening.

$$\Delta P_A = 0.00000346 \frac{G_A^2}{S}$$

= pressure drop through leakage
area.

Determine type of flow region from:

$$\frac{C_1 D G_s}{Z} \leq 2 < \frac{C_1 D G_s}{Z}$$

For $\frac{C_1 D G_s}{Z} \leq 2$ (viscous)

$$C_1 = \frac{G_s}{S} Z^{0.75} Z_w^{0.25}$$





















$$\Delta P_s = 0.00000152 C_1 C_7 L$$

= pressure drop through cross-flow
area.

Pressure Drop Leakage Correction Factors—Table I

F	F ₁	F ₂	F ₃	F ₄	F ₅
0	1	1	1	1	1
0.05	0.95	0.951	0.909	0.986	0.977
0.10	0.90	0.902	0.822	0.972	0.954
0.15	0.85	0.855	0.739	0.957	0.929
0.20	0.80	0.810	0.660	0.941	0.905
0.25	0.75	0.766	0.586	0.925	0.880
0.30	0.70	0.722	0.515	0.909	0.853
0.35	0.65	0.681	0.448	0.891	0.827
0.40	0.60	0.640	0.384	0.873	0.799
0.45	0.55	0.600	0.329	0.854	0.771
0.50	0.50	0.562	0.276	0.834	0.741
0.55	0.45	0.525	0.226	0.813	0.711
0.60	0.40	0.490	0.182	0.790	0.678

Pitch and Diameter Correction Factors—Table II

		C ₁	C ₂	C ₃	C ₄	C ₅
5/8-in. O.D. 13/16-in. Pitch		0.8641	0.930	0.801	4.050	2.375
		0.8641	1.156	0.995	2.910	1.713
		1.1531	1.145	1.059	1.840	1.387
		1.1531	0.998	0.922	2.645	1.990
5/8-in. O.D. 7/8-in. Pitch		1.1619	0.878	0.814	2.450	1.858
		1.1619	1.095	1.012	1.761	1.337
		1.4970	1.085	1.070	1.175	1.109
		1.4970	0.948	0.931	1.449	1.361
3/4-in. O.D. 15/16-in. Pitch		0.7234	0.850	0.732	3.790	2.240
		0.7234	1.058	0.913	2.725	1.611
		0.9906	1.048	0.976	1.649	1.280
		0.9906	0.915	0.947	2.030	1.575
3/4-in. O.D. 1-in. Pitch		0.9609	0.812	0.750	2.350	1.775
		0.9609	1.010	0.934	1.691	1.278
		1.2649	1.000	0.989	1.089	1.086
		1.2649	0.874	0.861	1.342	1.280
1-in. O.D. 1 1/4-in. Pitch		0.7234	0.709	0.655	2.135	1.618
		0.7234	0.882	0.817	1.531	1.163
		0.9906	0.874	0.871	0.931	0.920
		0.9906	0.761	0.761	1.172	1.132

Flow is normal to configurations shown.

Calculate

$$\left[\frac{\Delta P_s + \Delta P_w}{\Delta P_s - 0.25 \Delta P_w} \right]$$

Read F from Fig. 1Read F_1 and F_2 from Table I

$$\Delta P_{\text{shell}} = \Delta P_s F_1 (N + 1) + \Delta P_w F_2 (N)$$

= actual shell pressure drop.
C₃ from Fig. 3

$$h_{\text{shell}} = 13.2 C_3 C_4 F_4$$

$$\text{For } \frac{C_1 D G_s}{Z} > 2 \text{ (turbulent)}$$

$$C_3 = \frac{G_s^{1.25}}{S} (Z_w^{0.14})$$

$$\Delta P_s = 0.00000115 (C_2 C_3 L)$$

NOMENCLATURE

Correlating Constants

- C_1 Diameter and pitch constant (general)
 C_2 Pitch and diameter constants for heat transfer (viscous)
 C_3 Pitch and diameter constants for heat transfer (turbulent)
 C_4 Pitch and diameter constants for pressure drop (viscous)
 C_5 Pitch and diameter constants for pressure drop (turbulent)
 C_6 Flow, property variable for heat transfer (viscous)
 C_7 Flow, property variable for heat transfer (turbulent)
 C_8 Flow, property variable for pressure drop (viscous)
 C_9 Flow, property variable for pressure drop (turbulent)

Bundle Penetration and Leakage Area Factor

- F Leakage factor
 F_1 Leakage effect on ΔP_s (viscous)
 F_2 Leakage effect on ΔP_w (general)
 F_3 Leakage effect on ΔP_s (turbulent)
 F_4 Leakage effect on Δh_{shell} (viscous)
 F_5 Leakage effect on h_{shell} (turbulent)
 A_A Actual annular area between shell I.D. and baffle O.D., = $\frac{1}{4} \pi (D_s^2 - D_b^2) K$, in.²
 A_w Actual net free area through baffle opening, in.²
 A_s Actual minimum free cross flow area across bundle between baffles, in.²
 D Tube diameter, outside, in.
 D_s Shell diameter, inside, in.
 D_b Baffle diameter, outside, in.
 G_A Mass velocity through A_A , lb./ft.²/sec.
 G_w Mass velocity through A_w , lb./ft.²/sec.
 G_s Mass velocity through A_s , lb./ft.²/sec.
 h Heat transfer coefficient of shell side fluid corrected for leakage, Btu./hr. ft.² °F.
 K_1 Effective fraction of baffle to shell annulus
 K_2 Effective fraction of bundle width for pressure drop, ΔP_s
 L Average length of travel of fluid in one crossing of bundle, equals D , K_2 , in.
 N Number baffles in exchanger
 ΔP_A Apparent pressure drop through A_A based on total W_T , lb./in.²
 ΔP_w Apparent pressure drop through A_w based on total W_T , lb./in.²
 ΔP_s Apparent pressure drop through A_s based on total W_T and L
 ΔP Actual shell pressure drop, lb./in.²
 S Specific gravity shell fluid at mean temp. (water = 1.0)
 W_T Total quantity shell fluid flowing, lb./hr.
 Z Viscosity of shell fluid at mean temperature, cp.
 Z_w Viscosity of shell fluid at wall temperature, cp.

Estimating Factors

P = Process equipment costs delivered

1. Process equipment installed.....	1.1P to 1.15P
2. Piping, process building (a).....	1.5P to 2.9P
3. Instrumentation, process.....	0.75P to 1.0P
4. Special shielding and equipment (b).....	1.0P to 1.3P
5. Process building (c).....	1.2P to 4.5P
6. Laboratory and administration bldg. complete.....	2.8P to 3.8P
7. Reactor fuel storage bldg. complete (c).....	0.68P to 1.5P
8. Gaseous waste disposal system (d).....	1.3P to 1.4P
9. Liquid waste disposal system (e).....	1.8P to 2.8P
10. Waste disposal building (c).....	0.72P to 1.4P
11. Service building complete.....	0.85P to 1.2P
12. Site development (g).....	1.0P to 1.6P
13. Total installed physical costs.....	Sum of items 1 through 12
14. Construction overhead including fee (f).....	40% to 50% of item 13
15. Total construction costs.....	Sum of items 13 and 14
16. Engineering.....	10% to 20% of item 15
17. Contingency.....	10% to 50% of items 15 and 16
18. Preoperational costs (h).....	6 mo. to 1 yr. operating costs
19. Total capital costs (i).....	Sum of items 15, 16, 17, 18

- Factors are for direct maintenance plants processing enriched spent reactor fuels.
- (a) Piping costs include all labor and material for process piping, service piping, chemical drains, and pipe sleeves through concrete.
 - (b) Items included here are peculiar to radiochemical plants, i.e. chargers, samplers, radiation monitors, etc.
 - (c) Building cost is very sensitive to criticality and shielding.
 - (d) Includes particle and chemical cleanup systems and tall stack for final dispersal.
 - (e) Includes evaporator for concentration of liquid to be permanently stored as well as storage tanks. Storage tanks can be carried as operating charge but interest on investment tied up must be carried.
 - (f) Includes equipment rental and expense.
 - (g) Site development includes power lines, water supply, roads, fences, guard houses, fire lines, etc., but not land costs.
 - (h) Personnel training, test runs, cold operation, manual preparation.
 - (i) To this cost should be added interest on construction money, working capital, land costs, and owners expense.

Estimating Costs for Radiochemical Plants

NOW REVEALED: Costs—both capital and operational—for radiochemical plants. Private industry now has a good yardstick for estimating purposes.

W. G. STOCKDALE, Oak Ridge National Laboratory

Recent action of the Atomic Energy Commission has opened the way for private industry in the field of separation of fissionable material from depleted power reactor fuel. This article deals with the capital and operating costs involved in a radiochemical plant. It is primarily concerned with methods of estimating the cost of such a facility com-

plete with all necessary auxiliaries.

Scope of this article is limited to data on known and proven solvent extraction processes in the field, obtained from direct maintenance plants. It is based on facilities built and operated for the Atomic Energy Commission by private contractors.

Previous quick methods of cost

estimating of chemical plants published in open literature have been found unsatisfactory for successful application in this particular field. This is because of the requirements of radiation more than any other single item, even though all units are manufactured and constructed of time-proven materials.

Radiochemical separations plants consist of the same general definable areas found in non-radiochemical plants: (1) processing area, (2) service area, (3) raw material storage area, (4) laboratory area, (5) administration area, (6) development of the site, and (7) some means of disposal of the waste from the processing area.

Therefore, what is the difference in design, construction, operation, and cost of each in such a facility? To answer the question we will review each area separately.

Process Area

The process area, common to the chemical industry, contains processing equipment, chemical makeup equipment, control equipment, operating space, and other incidentals such as offices and rest rooms.

Processing equipment for materials of low enrichment is small compared with that in a heavy chemical plant, and smaller still for a highly-enriched material. Chemical makeup equipment is standard. Control equipment and instrumentation is very extensive and complex, and is constructed of commercially-available standard individual units.

The engineer is confronted with one fact that has no counterpart in the chemical industry. Namely, the raw materials feed to the plant is radioactive. This fact is responsible for the abnormal costs, and the effect is felt in each and every area.

In the process area, radioactivity must be considered from two standpoints: (1) criticality—that is, control by vessel spacing, geometry, batch size, or concentration to ensure that the process material will

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not under any circumstances lead to a self-sustaining neutron chain reaction, and (2) protection of personnel from beta and, even more dangerous, gamma radiation.

Criticality affects the building size by dictating the number and spacing of vessels.

Radiation protection affects the building design and cost by making remote operation mandatory behind or inside heavily-shielded cubicles, cells, or canyons.

Shielding usually consists of concrete walls up to 6 ft. thick, depending on the intensity of the gamma radiation emitted from the process streams and vessels. Generally speaking, the longer the irradiation time in the reactor and shorter the time between removal of the depleted fuel elements from the reactor and the start of processing, the higher the gamma intensity.

The concrete walls, constructed of commonly used material, are expensive since a multitude of sleeves for service and instruments honeycomb the face of the walls. These pipe sleeves must be offset on passing through the wall to ensure a minimum of radiation leakage. The accuracy required in setting these pipe sleeves in the concrete forms increases the labor cost of form construction.

Cells or canyons housing process equipment are lined with stainless steel on the floor and to varying heights around the walls. Purpose of the stainless steel linings is to facilitate decontamination in case of a leak from the process vessels or pipes. A leak of a highly-radioactive process stream on unprotected concrete almost always requires chipping away and replacement of the concrete beyond the point of penetration for complete decontamination. This is a costly maintenance procedure.

Because of the complexity of process equipment and piping, all labor costs are higher than for comparable items in ordinary chemical processing. Process equipment specifications call for rigid welding and inspection procedures.

Piping, because of radiation damage to and adsorption on known gasket material, must be either installed with all metal contact fittings (subject to careful and painstaking installation for insurance against leakage) or must be all welded. Inspection and testing of

the piping, once installed, are designed to ensure that it will function without any leakage. Process equipment and piping in critical locations are often duplicated to maintain on-stream time and to allow for scheduled decontamination and maintenance.

Valves are remotely operated, and are expensive items because of no-leakage and long-life maintenance-free requirements.

Pumps and other items of equipment that must be routinely maintained are installed in duplicate and are located in isolated cubicles, so that other items of equipment will not have to be decontaminated before maintenance can be performed on these.

Another above-normal cost in the process area is the ventilation requirement of air movement from non-radioactive to radioactive areas, to minimize the spread of airborne activity in case of an accident. Radiation detection instruments, personnel monitoring equipment, heavily-shielded and remotely-operated sampling equipment, and lead pigs and carts on conveyors for removing process control samples to the laboratory are other expensive items that have no counterpart in ordinary chemical processing.

The process building and equipment can be summarized as follows:

Design, inspection, and construction of the process installation are concerned with maximum life to avoid costly decontamination and maintenance. The building and auxiliaries are constructed to ensure maximum protection to personnel from radiation. These factors all add up to increased cost.

Raw Material Storage

Raw material storage, or depleted reactor fuel element storage, area differs appreciably in radiochemical plants from that in normal chemical plants. Here again, criticality and radiation protection plus decay time (length of storage required before processing) are the controlling factors.

The usual type of storage area required is a concrete basin containing water under which the elements are stored. Provisions must be made for unloading carriers under water, storage of the elements until required, cranes and tools for handling the elements, and some method of transferring the elements to the first process vessel.

Control of the storage water must be such as to minimize corrosion of the elements and to discourage the growth of algae. Size of the basin is controlled by fuel element design capacity and decay time. Provisions must be made both at the discharge end of the reactor and at the receiving end of the chemical plant for this storage.

Laboratory

The laboratory required for radiochemical processing plants requires specialized equipment. Basic requirements of the area are as follows: (1) hot cell, (2) emission spectrographic laboratory, (3) general-purpose laboratory, (4) dark room, (5) counting room, (6) sample preparation laboratory, and (7) other space such as offices, wash rooms, and storerooms. For plants processing raw material of greater than 3% enrichment, a mass spectrographic laboratory is also required.

Hot analytical cells require 4 to 5-ft. concrete walls with viewing windows and remote manipulators at a basic construction cost of approximately \$50,000 per cell unit. Mass spectrographic and emission spectrographic equipment is expensive. Unit construction cost for such a laboratory will vary from \$35 to \$75 per sq. ft. complete depending upon the type of architecture and type of equipment.

Waste Disposal

Disposal of radioactive waste—liquid, gaseous, and solid—poses serious design problems and economic considerations. Control of all radioactive plant waste must be maintained until such time as it can be released without harmful effects. Two basic methods are available, storage and dispersal. Both are used in radiochemical plants.

Liquid waste disposal is accomplished by long-time storage either in the acid state or with neutralization. It may be accompanied by evaporation for volume reduction. The tremendous amounts of fission product heat released per unit volume allows, in some cases, self-concentration to a near-solid mass.

Means of cooling is a necessity to avoid high corrosion rates in the case of acid storage, and to prevent the material from precipitating and crusting where there is danger of eruption from local overheating in the case of caustic storage.

Activity level of the stored waste dictates underground installations or location behind heavy concrete. The former is preferred because of lower cost. Seven to 10 ft. of earth (or concrete equivalent) is required for shielding. Tank design is standard, except for rigid welding specifications to practically eliminate the possibility of leakage and consequent ground or underground stream contamination.

Gaseous waste disposal consists in the physical removal of particulate matter, chemical removal of chemically active gases, and dispersal of inert gases into the atmosphere.

Physical removal of particulate matter is usually accomplished by highly efficient filters.

Chemical removal (primarily concerned with radioactive fission product iodine, which has a half-life of eight days) is very dependent on the time of decay of the elements before processing. After approximately 120 days of decay, the radioactive iodine has been reduced to the point where it is no longer a problem.

Dispersal of the gases into the atmosphere is accomplished from high stacks, with 250 ft. height being the usual minimum. Stack height is dependent on atmospheric conditions at any particular site. It is designed to give immediate plant protection from concentrated gases, and to give wide dispersal of the ejected gas stream before it becomes a threat to off-site populated areas. All gas streams containing radioactive material, as well as any ventilating air such as cell air that cannot be decontaminated in case of an emergency, is discharged to the atmosphere by means of the stack.

Solid waste is disposed of by burying. Combustible material can be reduced in volume by firing in incinerators, but this necessitates cleaning another air stream from contamination. Sufficient land must be provided for burial, because many years will be required before the land is again usable.

Personnel

Direct operating labor for a radiochemical plant will usually consist of five men per shift plus supervision. Supporting labor consists of analysts to staff the laboratory, health physicists, common labor, all crafts for maintenance—as well as

For a Direct-Maintenance Radiochemical Processing Plant

Capital Cost Distribution

Process Building with Equipment	
Process equipment	
Pipe, valves, and fittings	
Instruments and controls	
Electrical (process)	
Special equipment	
Process building with services	

Material and Labor

\$678,731
1,734,770
574,988
93,766
761,503
2,511,009

\$6,354,767

Waste Disposal

Liquid waste collection and disposal	
Gaseous waste collection and disposal	
Waste disposal building with services	

1,614,596
843,942
858,892

\$3,317,430

Administration and laboratory building

Fuel storage building	
Service buildings	
Yard facilities	

2,221,848
908,556
693,332
940,985

Total Labor and Material

Construction overhead and fee	
Engineering, including fee	

\$14,436,918
7,001,956
3,773,357

Total Construction and Engineering

\$25,212,231

Operating Cost Distribution (No amortization included)

Direct Cost

Direct operating labor	
Direct supervision	
Process chemicals and supplies	
Utilities	
Maintenance and repair	
Product control laboratory	
Process improvement laboratory	
Engineering department	

12.3
4.9
9.9
20.3
17.1
29.0
6.0
0.5

100.0

General Plant Expense

Overhead	
Administrative	
Health physics	
SF accountability	
Other	

11.4
21.4
9.9
3.5
11.3

57.5

office, engineering and administrative personnel. Additional personnel for plant improvement investigations are usually included. Total payroll for operation of a radiochemical plant will approximate 150 people.

Capital Cost Distribution

Actual capital cost involved in the construction of a direct-maintenance solvent-extraction plant for recovery of highly-enriched uranium is shown in the table. It is believed that these costs represent the upper limit of a plant capable of processing a number of types of fuel elements at varying plant throughputs—up to approximately 75 lb. of enriched uranium per day.

Plant size is dependent on the total weight of material throughput—that is, the uranium plus cladding and alloy material. Any mechanical means of removing as much inert material as possible will reduce process equipment size. No such mechanical equipment is included in these cost figures. Liquid waste storage tanks pro-

vided for this facility are of stainless steel and the facility includes an evaporator system for preconcentration.

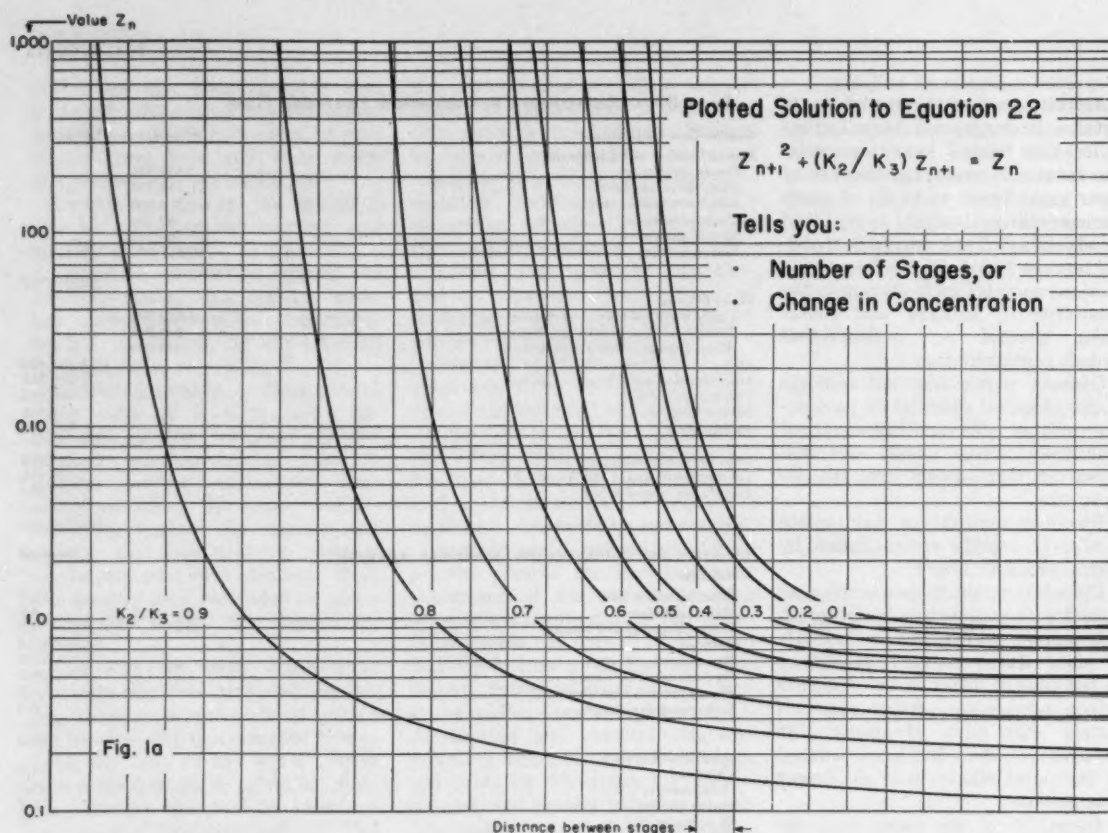
Operating Cost Distribution

A percentage distribution of operation costs of a facility such as that described above is given. Total payroll is approximately 200 people.

Cost Estimating Factors

A range of factors useful for quick estimates of direct-maintenance solvent-extraction radiochemical processing plants is presented in the table on p. 185. Upper limits shown are based on detailed knowledge of the costs presented in the capital cost distribution table. Lower limit is based on other facilities and studies made in methods of reducing the first plant cost.

Radiochemical processing is in its infancy, and it is to be expected that research will cause considerable variation in the percentages presented. However, their present usefulness should not be underestimated.



Finite Difference Calculations: New

Charts given here tell at a glance how many contact steps you'll need for a batch extraction that involves immiscible liquids.

JAMES G. KNUDSEN, Oregon State College

CERTAIN chemical engineering operations such as distillation, absorption and extraction are carried out in a stagewise manner on a commercial scale. In these operations we are interested in the concentration of the process stream as a function of the number of stages.

This concentration is not a continuous function but has values only at discreet points that correspond to an integral number of stages. For example, we can express a concentration value, C , as a function of the number of stages, n , in the process:

$$C = f(n); n = 1, 2, 3, 4, \text{etc.} \quad (1)$$

Values of C at nonintegral values of n have no physical meaning.

Now, if we were considering operations with continuous concentration gradients instead of stagewise contacting, we could use the differential and integral calculus of continuous functions to solve for concentration values. However, for the solution of stagewise concentration problems, we must resort to the calculus of finite differences. The calculus of finite differences is the discrete-interval counterpart of the calculus using infinitesimals with continuous variations.

In this article, we will apply the calculus of finite differences to the

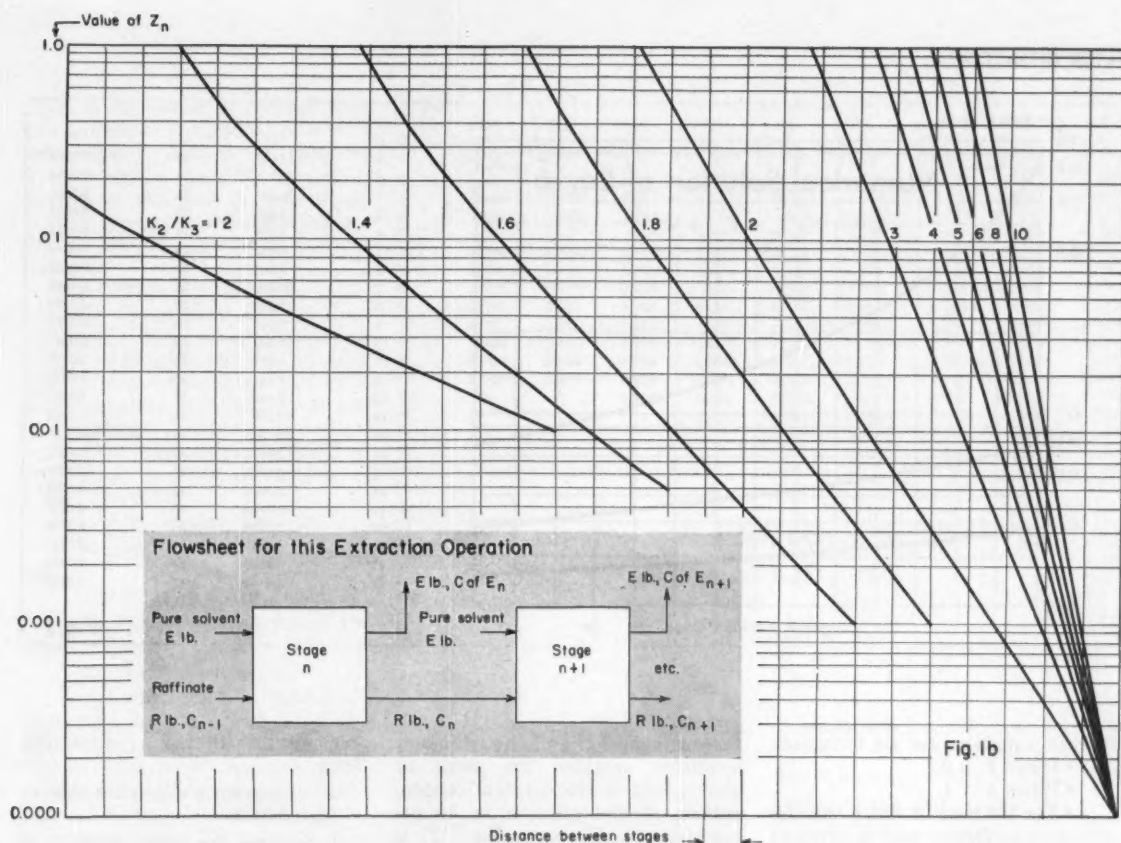
batch extraction of a solute from solution using a solvent which is immiscible in the solution. Through the use of this approach we have been able to arrive at the time-saving charts shown above and on p. 190.

You can use these charts for quick solutions to these extraction problems:

- Given one concentration of solute, how many stagewise contacts will be needed to get to any other concentration?

- Given the number of stages available, what change in concentration can be expected?

These problems have been con-



Look at Batch Extraction

sidered previously but only where the distribution coefficient for the solute between the phases is a constant.* Our analysis considers the more practical case where the distribution is not a constant but is a linear function of the concentration in one of the phases.

Although we will limit ourselves in this article to problems in batch extraction, we'd like to emphasize that the same approach will prove useful in other stagewise contact operations such as distillation, evaporation, vaporization, absorption, adsorption, leaching and sublimation as well as in liquid-liquid extraction.

DIFFERENCE EQUATIONS

Consider stages n and $n + 1$ of a batch operation in which equal amounts of pure extraction solvent are used successively in each stage to extract the solute out of a raf-

finated solution. (See sketch insert on Fig 1b, above.)

At each stage the amount of pure extraction solvent used is E lb., while the amount of solute-free raffinate at each stage is R . Composition of the extract leaving the n th stage is C_n lb. of solute/lb. of solute-free solvent. The concentration of the raffinate leaving the n th stage is C_n .

We'll assume that equilibrium is reached in each stage. A solute material balance on stage $n + 1$ gives:

$$\begin{array}{lcl} \text{Input} & = & \text{Output} \\ RC_n & = & EC_n + RC_{n+1} \end{array} \quad (2)$$

Stage n Stage $n + 1$

In order to express Eq. (2) in terms of C alone, we must know the equilibrium relationship between C and C_E . It is usual to express the distribution of a solute between two immiscible phases in terms of a distribution coefficient

which is the ratio of the concentration of the solute in the two phases. We will express the distribution coefficient, C_E/C , as follows:

$$C_E/C = aC^b \quad (3)$$

where a and b are constants to be evaluated. Also,

$$C_E = aC^{b+1} \quad (4)$$

Hence, for stage $n + 1$,

$$C_E = aC_{n+1}^{b+1} \quad (5)$$

Substituting Eq. (5) into Eq. (2) gives:

$$RC_n = EaC_{n+1}^{b+1} + RC_{n+1} \quad (6)$$

or,

$$(R/Ea)C_n = C_{n+1}^{b+1} + (R/Ea)C_{n+1} \quad (7)$$

If we let $K_1 = R/Ea$, Eq. (7) becomes

$$C_{n+1}^{b+1} + K_1C_{n+1} - K_1C_n = 0 \quad (8)$$

Eq. (8) is the finite difference equation that relates the concentration of the solute in the raffinate layer to the number of extraction stages.

A practical solution of this dif-

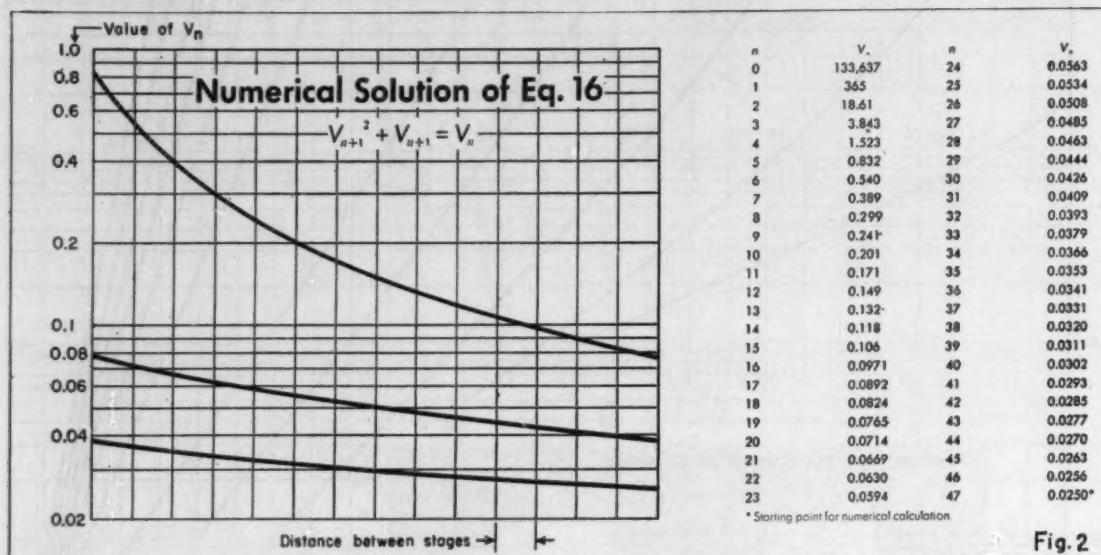


Fig. 2

ference equation can be obtained:

- When $b = 0$.
- When $b = 1$.
- For the case in which the distribution coefficient may be given as $C_n/C = d + eC$; where d and e are constants. Although it is impossible for this equilibrium relation to hold over the entire concentration range, the equilibrium data can be approximated by this relation for short ranges.

FIRST-ORDER EQUATIONS

For the case when $b = 0$, Eq. (8) becomes

$$C_{n+1} + K_1 C_{n+1} - K_1 C_n = 0 \quad (9)$$

or,

$$(1 + K_1)C_{n+1} - K_1 C_n = 0 \quad (10)$$

Eq. (10) is a first-order linear difference equation and it is necessary to know one boundary condition to get a complete solution. This boundary condition is the concentration, C_n , of the original solution entering the first stage. Eq. (10) may be solved analytically³ and introducing the boundary condition gives this solution:

$$C_n = C_0 [K_1 / (1 + K_1)]^n \quad (11)$$

This result has been reported previously by Sherwood³ for the case where the distribution coefficient is constant.

For the case when $b = 1$, Eq. (8) becomes

$$(C_{n+1})^2 + K_1 C_{n+1} - K_1 C_n = 0 \quad (12)$$

Eq. (12) is still a first-order dif-

ference equation and the boundary condition remains the same as above, that is the original concentration of the solution to be extracted is C_0 . However, Eq. (12) is nonlinear and no analytical solution exists for it.

But this equation can be solved very easily by numerical methods and the results tabulated and plotted. By defining C_n in terms of a new variable, V_n , we obtain a difference equation that is independent of the parameter K_1 . Let

$$C_n = K_1 V_n \quad (13)$$

and

$$C_{n+1} = K_1 V_{n+1} \quad (14)$$

Substitute Eqs. (13) and (14) into Eq. (12). This gives the following equation:

$$(V_{n+1})^2 + V_{n+1} - V_n = 0 \quad (15)$$

which can be rearranged to the final form:

$$(V_{n+1})^2 + V_{n+1} = V_n \quad (16)$$

NUMERICAL SOLUTION

Now we can solve Eq. (16) numerically if we assume values for V_{n+1} and calculate values for V_n . As the number of extraction stages becomes infinitely large, C_n (and hence V_n) approaches zero. We can obtain a numerical solution by assuming a value of V_{n+1} as close to zero as we want. Any value of V_n for any smaller value of n may then be determined.

For example, here are the steps of a typical numerical calculation:

1. Assume that $V_{n+1} = 0.0250$. Then,

$$V_n = (0.0250)^2 + 0.0250 = 0.02563$$

2. Assume the value of $V_{n+1} = 0.02563$, which is the value of V_n from step 1. Then,

$$V_n = (0.02563)^2 + 0.02563$$

3. Assume the value of $V_{n+1} = 0.02629$, which is the value of V_n from step 2. Then,

$$V_n = (0.02629)^2 + 0.02629$$

These calculations are continued to large values of V_n . We have shown the results in the table on Fig. 2. In Fig. 2, V_n is plotted vs. n and the resulting curve can be used to solve a batch extraction problem in which the distribution coefficient is expressed by the relation $C_n/C = aC$.

Note that on Fig. 2 we have given no values of n on the abscissa. Since the difference equation has constant coefficients, the value of $n = 0$ may be taken at any point on the abscissa. It is sufficient to know that the distance between a pair of vertical lines on the figure corresponds to one equilibrium stage.

Problem 1

The problem that follows will show you how to use Fig. 2.

Given—A solution at 20°C. that contains 3.5 lb. of benzoic acid in

1,000 lb. of water is treated with two successive portions of pure benzene. Each portion of benzene weighs 200 lb. Assume that equilibrium is attained in each stage. We can express the distribution coefficient for this system as $C_n/C = 1,268$ C .

Find—What percent of the original acid is present in the final raffinate? How many extraction stages each with 200 lb. of pure benzene are required so that 10% of the original acid remains in the final raffinate.

Solution—We are given that $E = 200$ lb.; $R = 1,000$ lb.; and $a = 1,268$. Therefore,

$$K_1 = R/Ea = 1,000/(200)(1,268)$$

$$K_1 = 0.00395$$

and

$$C_n = 0.00395 V_n$$

The original concentration of the solution equals

$$C_o = 0.0035 \text{ lb./lb. of water}$$

$$V_o = 0.0035/0.00395 = 0.887$$

Therefore, at $n = 0$, $V_o = 0.887$. We obtain the value of V_n from Fig. 2. First locate the value 0.887 on the curve. Then, measure to the right a distance corresponding to two stages. Take the value of V at this point as the value for V_n . At $n = 2$, $V_n = 0.405$. From this,

$$C_2 = (0.405)(0.00395)$$

$$C_2 = 0.00160 \text{ lb./lb. of water}$$

The fraction of the original benzoic acid that remains in the final raffinate = $0.00160/0.0035$, or 45.6%.

Now how many extraction stages do we need to ensure that only 10%

Value of n	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	143.7	464.7	558.4	219.9	1,005.9	297.0	137.3	781.6	3,506.9
1	11.94	21.46	23.48	14.63	31.47	16.94	11.37	27.56	58.77
2	3.406	4.533	4.698	3.630	5.365	3.826	3.040	4.665	7.229
3	1.796	2.031	2.023	1.716	2.080	1.679	1.428	1.842	2.376
4	1.291	1.299	1.280	1.125	1.214	1.030	0.895	1.015	1.124
5	1.087	1.057	0.991	0.879	0.880	0.758	0.659	0.684	0.702
6	0.994	0.933	0.857	0.759	0.721	0.621	0.534	0.519	0.501
7	0.948	0.871	0.788	0.694	0.635	0.543	0.460	0.424	0.389
8	0.925	0.839	0.750	0.657	0.585	0.496	0.413	0.364	0.319
9	0.913	0.821	0.729	0.635	0.555	0.465	0.382	0.324	0.272
10	0.907	0.812	0.717	0.621	0.536	0.445	0.360	0.296	0.238
11	0.904	0.807	0.710	0.613	0.523	0.432	0.345	0.275	0.214
12	0.902	0.804	0.706	0.608	0.515	0.422	0.334	0.260	0.196
13	0.901*	0.802*	0.703	0.605	0.510	0.416	0.325	0.248	0.181
14			0.702*	0.603	0.507	0.411	0.319	0.239	0.169
15				0.602*	0.505	0.408	0.315	0.231	0.160
16					0.503*	0.406	0.311	0.226	0.152
17						0.404*	0.309	0.221	0.145
18							0.307	0.217	0.140
19							0.305*	0.214	0.135
20								0.212	0.131
21								0.210	0.127
22								0.208*	0.124
23									0.122
24									0.119
25									0.117
26									0.115
27									0.114*

* Starting point for numerical solution.

Numerical Solution of Eq. 22

$$Z_{n+1}^2 + (K_2/K_1)Z_{n+1} = Z_n$$

Table continued next page

of the original benzoic acid remains in the raffinate? As above, $C_o = 0.0035$ lb./lb. of water and $V_o = 0.887$. If 10% of the benzoic acid remains in the final raffinate, then $C_n = 0.00035$ lb./lb. of water and $V_n = 0.0887$. At $n = 0$, $V_o = 0.887$.

From Fig. 2, V_n has a value of 0.0887 at a distance that corresponds to 12.2 stages to the right of the point where $V_o = 0.887$. Therefore, 13 stages will be required.

LINEAR EQUILIBRIUM CASE

We'll consider now the case in which the distribution coefficient C_n/C can be expressed as $d + eC$; where d and e are constants.

If b in Eq. (8) has values that are different from 0 to 1, we obtain a nonlinear difference equation. The numerical solution of this equation is difficult, especially if b has a fractional value. Likewise, it is impossible to eliminate the parameter, K_1 .

However, in many cases the equilibrium data—over a limited concentration range—may be expressed by this linear function:

$$C_E/C = d + eC \quad (17)$$

where d and e are constants. We must emphasize that this relationship cannot hold over the entire concentration range. Where C is zero, C_n/C is also zero. This condition is not satisfied by Eq. (17). From Eq. (17), for stage $n + 1$

$$C_E = dC_{n+1} + eC_{n+1}^2 \quad (18)$$

Substitute Eq. (18) into Eq. (2).

Then,

$$RC_n = E(dC_{n+1} + eC_{n+1}^2) + RC_{n+1} \quad (19)$$

Divide by Ee and rearrange.

$$C_{n+1}^2 + [(R/Ee) + (d/e)] C_{n+1} = (R/Ee) C_n \quad (20)$$

If we let

$$K_2 = (R/Ee) + (d/e); \text{ and } K_1 = R/Ee$$

then

$$C_{n+1}^2 + K_2C_{n+1} = K_1C_n \quad (21)$$

Now, let $C_n = K_1Z_n$ and we obtain the final equation

$$Z_{n+1}^2 + (K_2/K_1) Z_{n+1} = Z_n \quad (22)$$

When K_2 is equal to K_1 , Eq. (22) becomes identical with Eq. (16) which we have already considered. When K_2 becomes zero—as may happen when values of d are negative—Eq. (22) becomes

$$Z_{n+1}^2 = Z_n \quad (23)$$

We can solve Eq. (23) analytically as follows:

$$Z_n = Z_o^{0.5/n} \quad (24)$$

where Z_o is the value of Z_n at $n = 0$.

We can solve Eq. (22) numerically. The table starting on this page shows results for values of K_2/K_1 from 0.1 to 10.0. Values of Z_n are plotted vs. n in Figs. 1a and 1b.

Problem 2

The worked-out problem that follows will show you how to use Figs. 1a and 1b.

Given—One liter of a benzene

Nomenclature

a, b	Constants in Eq. (3)
C	Concentration of raffinate layer, mass of solute/unit mass of solute-free solvent
C_n	Concentration of extract layer, mass of solute/unit mass of solute-free solvent
C_o	Initial concentration of raffinate, mass of solute/unit mass of solute-free solvent
d, e	Constants in Eq. (17)
E	Mass of solute-free extracting solvent used in each stage
f	Function of
K_1	Parameter equal to R/Ea
K_2	Parameter equal to $(R/Ee) + (d/e)$
K_3	Parameter equal to R/Ee
n	Number of extraction stages
R	Mass of solute-free raffinate entering each stage
V	A variable defined as $V = C/K_1$
Z	A variable defined as $Z = C/K_1$

BATCH EXTRACTION . . .

Value of n	1.2	1.4	1.6	1.8	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
0.....	1,943.8	7,959.3	2,361.5	326.3	693.7	292.2	164.5	183.9	4,508.0	340.0	1,903.0	—	235.3
1.....	43.49	88.52	47.80	17.19	25.36	15.66	10.98	11.29	61.94	15.29	39.81	98.48	11.13
2.....	6.022	8.734	6.160	3.342	4.134	2.732	1.870	1.688	5.423	1.748	3.471	6.397	1.011
3.....	1.986	2.337	1.808	1.138	1.266	0.732	0.423	0.317	0.798	0.241	0.413	0.662	0.100
4.....	0.912	0.981	0.765	0.496	0.505	0.227	0.103	0.0627	0.130	0.0343	0.0512	0.0730	0.010
5.....	0.528	0.513	0.385	0.243	0.227	0.0738	0.0256	0.0125	0.0216	0.0049	0.0064	0.0081	0.001
6.....	0.342	0.301	0.212	0.126	0.108	0.0244	0.0064	0.0023	0.0036	0.0007	0.0008	0.0009	0.0001*
7.....	0.238	0.190	0.123	0.0675	0.0525	0.0081	0.0016	0.0005	0.0006	0.0001*	0.0001*	0.0001*	
8.....	0.173	0.124	0.0737	0.0367	0.0259	0.0027	0.0004	0.0001*	0.0001*				
9.....	0.130	0.0839	0.0448	0.0202	0.0129	0.0009							
10.....	0.100	0.0575	0.0275	0.0111	0.0064	0.0003							
11.....	0.0784	0.0390	0.0170	0.0062	0.0032	0.0001*							
12.....	0.0621	0.0280	0.0106	0.0034	0.0016								
13.....	0.0497	0.0197	0.0066	0.0018	0.0008								
14.....	0.0401	0.0139	0.0041	0.001*	0.0004								
15.....	0.0325	0.0099	0.0026		0.0002								
16.....	0.0265	0.0070	0.0016		0.0001*								
17.....	0.0217	0.005*	0.001*										
18.....	0.0178												
19.....	0.0147												
20.....	0.0121												
21.....	0.010*												

* Starting point for numerical solution.

Numerical Solution of Eq. 22

$$Z_{n+1}^2 + (K_2/K_1)Z_{n+1} = Z_n$$

Table continued from previous page

solution that contains 0.10 gram-moles of picric acid per liter of solution is agitated with 2.0 liters of water. Assume that the volumes of the solutions remain constant. In the range of concentrations between 0.02 and 0.10 gram-moles/liter, the equilibrium data for the system can be represented within 5% by

$$C_R/C = 1.60 + 2.70 C$$

Find—The concentration of picric acid in the benzene when equilibrium is reached.

Solution—This is a single-stage extraction in which $R = 1$ liter; $E = 2$ liters; $d = 1.60$; $e = 27.0$; and $C_s = 0.10$ gram-moles/liter.

$$K_1 = R/Ee = 1/(2)(27.0)$$

$$K_1 = 0.0185$$

$$d/e = 1.60/27.0 = 0.0593$$

$$K_2 = (R/Ee) + (d/e)$$

$$= 0.0185 + 0.0593$$

$$K_2 = 0.0778$$

$$K_2/K_1 = 0.0778/0.0185 = 4.21$$

Now we can use Fig. 1b. At $K_2/K_1 = 4.0$,

$$Z_0 = 5.4; \text{ at } n = 0$$

$$Z_1 = 1.04; \text{ at } n = 1$$

At a value for K_2/K_1 equal to 5.0,

$$Z_0 = 5.4; \text{ at } n = 0$$

$$Z_1 = 0.95; \text{ at } n = 1$$

We can interpolate to get a final solution. At $K_2/K_1 = 4.21$,

$$Z_0 = 5.4; \text{ at } n = 0$$

$$Z_1 = 1.02; \text{ at } n = 1$$

Therefore, C_1 is equal to 0.019 gram-moles/liter.

METHOD COMPARES WELL

We have solved this same problem using actual equilibrium data for

this extraction system. We calculated a final concentration in the benzene solution of 0.020 gram-moles/liter which compares well with the calculation described in this article.

Although the worked-out example demonstrates the use of the charts for the case of a single-stage extraction, the charts will be most useful where more than one extraction stage is required. The sample problem also demonstrates the use of different concentration units than were originally defined. The



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assumption of constant solution volumes permits us to use the finite difference equation represented by Eq. (22).

TO SUMMARIZE

To summarize then, we have presented in this article a new look at the question of how to solve problems in batch extraction using immiscible liquids as solvents.

We have used the calculus of finite differences to arrive at the time-saving curves shown on pages 188, 189 and 190. With the help of these curves, problems in liquid-liquid extraction can be solved more quickly when the unknown to be found is either the number of stages required to go from one concentration to another or—when the number of stages available is known—the improvement in concentration that can be expected in stage-wise extraction.

ACKNOWLEDGEMENT

The author is indebted to Professor W. E. Milne, Chairman, Dept. of Mathematics, Oregon State College for his suggestions regarding the numerical solution of the difference equations.

REFERENCES

1. Hougen, O. A., K. M. Watson and R. A. Ragatz, "Chemical Process Principles," John Wiley & Sons, New York, 2nd ed. (1954).
2. Marshall, W. R. and R. L. Pigford, "The Application of Differential Equations to Chemical Engineering Problems," Univ. of Delaware, Newark, Del., 3rd printing (1952).
3. Sherwood, T. K., "Absorption and Extraction," McGraw-Hill Book Co., Inc., New York, 1st ed. (1937).
4. Tiller, F. M. and R. S. Tour, *Trans. A.I.Ch.E.*, 40, p. 317 (1944).

With a chart like this for any given tray design, you can estimate

Q liquid-handling capacity

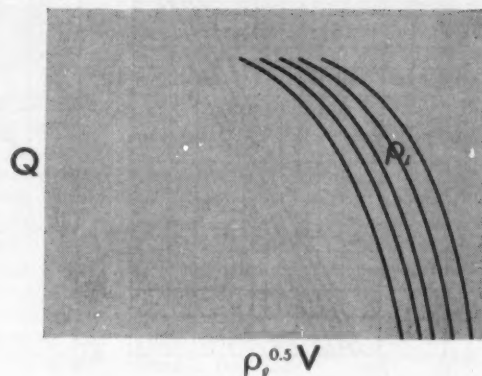
for any combination of

V vapor rate

ρ_v vapor density

ρ_l liquid density, and

you may be able to . . .



Save Money on Bubble-Cap Columns

T. J. WALSH and P. G. LAFYATIS, Case Institute of Technology

For almost any distillation, absorption or stripping job you can usually buy a bubble-cap column designed for the specific operating conditions. However, a tailor-made column is not always the most economical one. Here's why:

In the first place, you may have on hand an idle column which you could convert to the desired service. Or you might be able to pick up a second-hand column or a "cancellation" job much cheaper than a new one.

Even if you buy a new column, you may find it cheaper to accept a standard "stock" design of tray and caps. Standard designs are now available from many manufacturers. Although they provide only limited choice as to cap or tray dimensions, you can buy them at considerable savings over the cost of special designs.

In either event, you will have to be sure that the tray you are getting will handle the vapor and liquid loads satisfactorily under the desired operating conditions. This article will show how you can check the capacity of conventional tray designs by a relatively simple procedure.

End result of this procedure is a set of charts defining the limits of satisfactory performance for your particular tray design. You can tell from the master chart (like the small one above) whether or not the proposed vapor and liquid flows are

within these limits. Based on the tray dimensions, this chart relates flow rates and densities of liquid and vapor streams. You need not consult the other charts unless the master chart indicates difficulty and you want to locate the source of the trouble.

Basis of Procedure

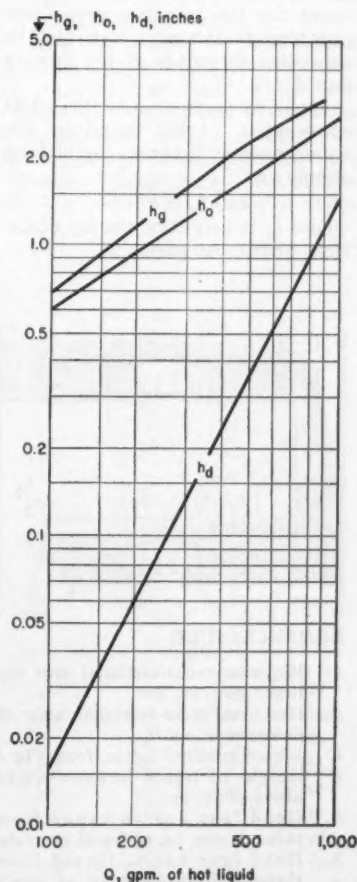
For satisfactory operation of a bubble-cap column, height of liquid in the downcomer H (see sketch, next page) must be sufficient to cause flow of liquid across the plate and to cover the slots in the caps. Ultimate capacity is determined by height of the downcomer.

Since H is the key to tray capacity, let's break it down for closer analysis.

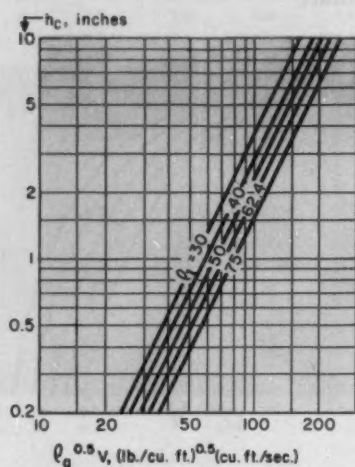
It is composed of six individual heads. First is the weir height h_w , which is constant under any flow conditions.

The next three components are functions of the rate of liquid flow—height of crest at the weir h_w , liquid gradient across the plate h_g , and head loss h_o necessary to cause flow through the downcomer onto the tray. Each of these heads can be considered in terms of inches of the flowing liquid.

The other two components are functions of the rate of vapor flow—friction loss h_f due to passage to vapor through the riser, annulus and slots to the tray above, and



FIRST step in deriving master chart is this three-curve plot (Fig. 1).

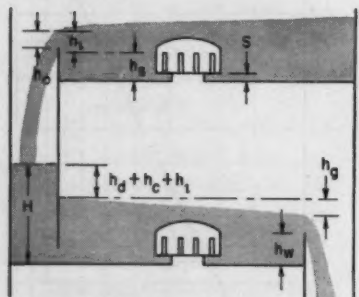
SECOND step is to plot h_c (Fig 2).

liquid head h_c , which the vapor must overcome on entering the tray above. These two heads, which account for the pressure drop from one tray to the next, can also be expressed in inches of the flowing liquid.

Ignoring (temporarily) the effect of aeration of the liquid by the vapor, we may estimate liquid head simply as:

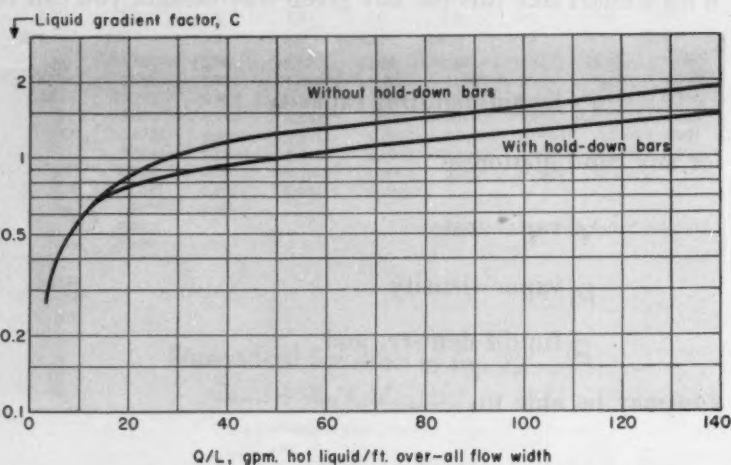
$$h_l = h_w + h_s - h_a \quad (1)$$

where h_s is height of the top of the slots above the plate.



NOMENCLATURE

- A. Minimum cross-sectional area for vapor flow, sq. ft.
- A_d Minimum cross-sectional area of downcomer, sq. ft.
- C Liquid gradient factor, from Fig. 3
- H Height of liquid in downcomer above plate, in.
- h_c Head loss due to vapor flow through cap, in. of liquid on plate
- h_d Head loss due to liquid flow through downcomer, in. of liquid
- h_g Liquid gradient across plate, in.
- h_l Liquid head above top of slots, in.

LIQUID gradient factor for computing h_c comes from this plot (Fig 3).

Eq. (1) neglects the effect of liquid gradient on the liquid depth and also the fact that the vapors actually issue from the slots at depths below the top of the slots. These are, at least in part, compensated for by a decrease in static liquid seal as the vapor rate is decreased.⁷

We can now combine the individual heads in an expression for buildup of liquid in the downcomer:

$$H = h_w + (h_s - h_a) + 2h_c + h_d + h_s \\ = 2h_w + 2h_s + h_d + h_c - h_a \quad (2)$$

Eq. (2) makes no allowance for

foam in the downcomer. Some tray designs allow separation of foam before the liquid enters the downcomer; others depend on rapid breaking of the foam in the downcomer itself.

According to Kemp and Pyle,⁸ aeration factors (increase in pressure drop per unit increase in liquid depth) generally average about 0.7 and may be as low as 0.5 for the liquid as it flows across the tray. If we assume that this liquid flows directly into the downcomer, we

- h_c Height of liquid crest above weir, in.
- h_s Height of top of slots above plate, in.
- h_w Weir height, in.
- L Over-all average flow width, ft.; computed as (tower cross-sectional area - area of two downcomers) / length of liquid travel
- l_c Free space between caps normal to liquid flow, total in. per average row
- l_r Free space between risers normal to liquid flow, total in. per average row
- l_w Weir length, in.
- Q Liquid flow, gpm.
- r Number of rows of caps
- s Clearance between cap skirt and plate, in.
- u_v Vapor velocity through minimum cross-section of vapor path, ft./sec.
- u_l Liquid velocity through minimum cross-section of downcomer, ft./sec.
- V Vapor flow, cu. ft./sec.
- ρ_v Vapor density, lb./cu. ft.
- ρ_l Liquid density, lb./cu. ft.



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Key Dimensions of Isobutane Tower

Diameter.....	10.0 ft.
Tray spacing.....	27 in.
Weir length, l_w	75.1 in.
Weir height, h_w	2.0 in.
Number of rows of caps, r	11
Height of top of slots above plate, h_s	1.75 in.
Clearance between cap skirt and plate, s	0.375 in.
Minimum cross-sectional area for vapor flow, A_s	9.1 sq. ft.
Minimum cross-sectional area of downcomer, A_d	1.37 sq. ft.
Over-all average flow width, L	9.0 ft.
Free space between caps normal to liquid flow, l_c	32.95 in.
Free space between risers normal to liquid flow, l_r	51.1 in.

have to limit the height of foam-free liquid in the downcomer to 50% of the downcomer height. For sound practice let's include an additional factor of safety and limit H to 40% of downcomer height. (For these calculations, effective downcomer height is the tray spacing plus the height of the weir.)

Estimation of Individual Heads

Of the terms in Eq. (2), h_w and h_s are fixed by tray and cap design. Vapor rate determines h_c . Liquid rate determines h_d , h_a and, for all practical purposes, h_p .

The following modification of the Francis weir formula, based on a straight segmental downcomer, gives the liquid head at the weir:

$$h_w = (Q/2.98 l_w)^{0.657} \quad (3)$$

where Q is the liquid flow rate over the weir in gpm. and l_w is the weir length in inches. Although various investigators have proposed corrections to this formula, we believe from our experience that Eq. (3) is satisfactory in most cases.

Head loss in downcomer h_d will be small in a well designed tray. You should check this to guard against restrictions to flow at this point, using Edmister's⁵ equation:

$$h_d = 0.8 u_i^2 \quad (4)$$

where u_i is the linear velocity (ft./sec.) of liquid through minimum cross-section of the downcomer.

In deriving this equation Edmister assumed one velocity head lost on expansion and 0.5 velocity head in contraction as the liquid passed through the constriction of the downcomer. Other modifications of this equation have the same form but use coefficients varying from 0.56 to 0.93.

For convenience, let's rewrite Eq. (4) in the same form as the Francis weir formula:

$$h_d = 0.56 (Q/449 A_d)^2 \quad (5)$$

where A_d is the minimum cross-

sectional area of the downcomer in sq. ft.

Considering the liquid gradient across the tray as a function of liquid rate only, we may use the equation of Davies⁴ to calculate h_p :

$$Q = 2.15 C l_c h_p^{0.5} Z/r^{1.5} \quad (6)$$

in which

$$Z = h_p (1.5r - 1.4) + 3r [h_w + h_s + s (l_r - l_w)]/l_c$$

Eq. (6) is for round caps spaced on equilateral triangles. It is based on the assumption that liquid level is below the top of the caps. Since in most operating towers the liquid level is above the caps, the equation gives conservative (high) values for h_p .

In practice we solve this equation by first assuming a value for Q , which determines h_c and the liquid gradient factor C (from Fig. 3). The other terms are fixed by tray design (see *Nomenclature*).

If you have actual liquid-gradient data for your specific cap and tray design you won't have to use Eq. (6).

The best method for determining pressure drop through bubble caps is that of Dauphine,⁸ which considers the dimensions of the cap. The equation of Chillas and Weir,¹ however, is much simpler and checks Dauphine's calculation within 10% at high rates of vapor flow:

$$h_c = 0.93 u_g^2 \rho_g / \rho_l \quad (7)$$



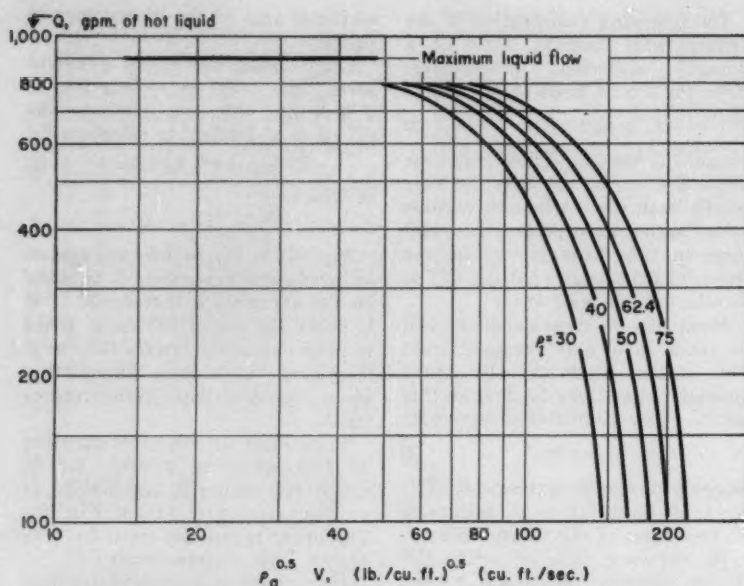
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Besides his research work at Case on organic syntheses and process automation, he has spent some time with Dow Chemical Co. in that company's Computations Laboratory.

Calculations for Construction of Figs. 1 and 4

Q, gpm.	h_w , in.	h_d , in.	L , ft.	Q/L	C	h_c , in.	H , in.
100	0.59	0.015	9.0	11.1	0.62	0.67	11.6
200	0.94	0.058	9.0	22.2	0.75	1.13	11.6
300	1.22	0.13	9.0	33.3	0.90	1.57	11.6
400	1.48	0.23	9.0	44.4	1.05	1.93	11.6
500	1.72	0.36	9.0	55.6	1.04	2.24	11.6
600	1.93	0.52	9.0	66.7	1.05	2.52	11.6
700	2.14	0.71	9.0	77.8	1.15	2.82	11.6
800	2.34	0.93	9.0	88.9	1.15	2.96	11.6
900	2.50	1.20	9.0	100	1.30	3.10	11.6

$\rho_l^{0.5} V, (\text{lb./cu. ft.})^{0.5} (\text{cu. ft./sec.})$							
h_w , in.	h_d , in.	h_c , in.	$\rho_l = 30$	$\rho_l = 40$	$\rho_l = 50$	$\rho_l = 62.4$	$\rho_l = 75$
2.0	1.75	7.5	143	164	182	200	220
2.0	1.75	6.3	132	151	168	183	203
2.0	1.75	5.2	120	137	152	167	184
2.0	1.75	4.2	108	123	136	150	166
2.0	1.75	3.2	94	108	119	132	144
2.0	1.75	2.5	84	95	104	117	129
2.0	1.75	1.5	65	74	81	91	99
2.0	1.75	0.8	47	54	59	67	73
2.0	1.75	0.0	....	....	....	....	....



MASTER chart defines area of satisfactory tray performance (Fig. 4).

in which u_v is the linear velocity (ft./sec.) of vapor through the minimum cross-section of vapor path.

At low vapor velocities Eq. (7) gives very low values. However, since limiting operating conditions will generally occur when vapor velocity is high, this equation suits our purpose. Other authors recommend a similar form of equation with coefficients ranging from 0.51 to 1.43. The lower coefficients seem to have been derived from studies of dry caps, while the higher coefficients appear too conservative.

For convenience, let's rewrite Eq. (7) in terms similar to Eq. (5):

$$h_c = 0.93 \rho_g V^2 / \rho_l A^2 \quad (8)$$

where V is vapor flow in cu. ft./sec. and A is the minimum cross-sectional area of the vapor path.

Preparation of Charts

We can represent Eqs. (3), (5) and (6) graphically by plotting h_c ,

h_d and h_w , respectively, against Q (Fig. 1). If we use logarithmic coordinates we get straight lines for Eqs. (3) and (5), with slopes of 0.667 and 2.0. Computation of two points for each equation will locate these lines quickly. Eq. (6), unfortunately, does not yield a straight line, and we must compute several points to define the curve.

We can also construct a log-log plot for Eq. (8) by grouping $\rho_g^{0.5} V$ with V and drawing separate straight lines (slope = 2.0) for various values of liquid density ρ_l (Fig. 2). In most cases a liquid density range of 30 to 75 lb./cu. ft. is satisfactory.

For the master chart (Fig. 4) we have found it best to plot Q vs. $\rho_g^{0.5} V$, with liquid density as a parameter. This is the procedure:

First select any value of Q . For this Q determine from the proper charts the values of h_c , h_d , and h_w . With h_c and h_d known from tray dimensions and H set as 40% of total downcomer height, calculate h_o from Eq. (2). This will be the frictional head loss due to vapor flow when vapor flow is at the maximum allowable rate for the assumed value of Q . From the vapor-flow chart find the values of $\rho_g^{0.5} V$ for various liquid densities and plot vs. Q .

The master chart thus completely defines the capacity of our particu-

lar tray design under varying conditions of loading.

Sample Calculation

With permission of Esso Research and Engineering Co., we shall use the isobutane tower described by Cicalese² for an illustrative example. Principal dimensions which apply to our problem are given in the upper table, p. 195.

From Eq. (3),

$$h_d = [Q / (2.98)(75.1)]^{0.667} = Q^{0.667} / 37$$

From Eq. (5),

$$h_w = 0.56 [Q / (449)(1.37)]^2 = Q^2 / 674,000$$

From Eq. (6),

$$\begin{aligned} Z &= h_o [(1.5)(11) - 1.4] + (3)(11) [2.0 \\ &\quad + (0.375)(51.1 - 32.95) / 32.95] \\ &= 15.1 h_o + 33 h_o + 72.9 \end{aligned}$$

$$\begin{aligned} Q &= 2.15 C (32.95) h_o^{0.5} Z / (11)^{1.5} \\ &= 1.94 C h_o^{0.5} (15.1 h_o + 33 h_o + 72.9) \end{aligned}$$

Assuming two values of Q , say 100 and 900, compute corresponding values of h_c and h_d , then draw the two straight lines of Fig. 1. Assume several values of Q from 100 to 900 and compute corresponding values of h_w , reading h_o from Fig. 1 and C from Fig. 3 as required. (These computations, as well as the subsequent ones, are recorded in the other two tables.) Draw the curve for h_o vs. Q also on Fig. 1.

From Eq. (8),

$$\begin{aligned} \rho_g^{0.5} V &= (h_c \rho_l)^{0.5} (9.1) / (0.93)^{0.5} \\ &= 9.45 (h_c \rho_l)^{0.5} \end{aligned}$$

Assume two values of h_c at each of five values of ρ_l to get the straight lines shown in Fig. 2.

At closely spaced values of Q from 100 to 900 compute h_o from Eq. (2), figuring H as $(0.4)(27 + 2) = 11.6$ in. From Fig. 2 find the values of $\rho_g^{0.5} V$ and ρ_l for each value of h_o , then plot as shown in Fig. 4, the master chart.

The area below and to the left of the curves in Fig. 4 is the area of satisfactory operation. Outside this area, the head in the downcomer may be too high, and operation is likely to exceed tray capacity.

REFERENCES

1. Chillas, R. B., and Weir, H. M., *Ind. Eng. Chem.*, 22, 206 (1930).
2. Cicalese, J. J., et al., *Proc. API*, 26, III, 180 (1946); *Petr. Refiner*, 26, 495 (1947).
3. Dauphine, T. C., "Pressure Drop Through Bubble Caps," Sc. D. thesis, Mass. Inst. of Tech., 1939.
4. Davies, J. A., *Ind. Eng. Chem.*, 39, 774 (1947).
5. Edmister, W. C., *Petr. Engineer*, 20, 193 (Dec. 1948).
6. Kemp, H. S., and Pyle, C., *Chem. Eng. Prog.*, 45, 435 (1949).
7. Rogers, M. C., and Thiele, E. W., *Ind. Eng. Chem.*, 26, 524 (1934).

Data for Construction of Fig. 2

ρ_l , lb./cu. ft.	$\rho_g^{0.5} V$	
	$h_c = 1$ in.	$h_c = 10$ in.
30	52.7	164
40	59.8	189
50	66.8	211
62.4	74.5	236
75	81.8	259

Chemical Engineering Fundamentals

Reactor Design for Catalytic Reactions—I

What are the problems involved in the design of catalytic chemical reactors? Here are the answers to selection and sizing.

T. E. Corrigan and W. C. Mills, Olin Mathieson Chemical Corp.

IN OUR earlier series on heterogeneous kinetics (*Chem. Eng.*, Nov. 1954 through July 1955) we considered the theoretical approach to the kinetics of catalytic vapor-phase reactions. Those nine installments emphasized the fundamentals of chemical adsorption, the derivation of heterogeneous reaction rate equations and the interpretation of kinetic data.

However, our emphasis was entirely on simple reactions (that is, the case where only one reaction takes place at a time) although the rate equations that we derived were not simple. In our previous discussion there was no consideration given to problems that are involved in the actual solution of specific reactor design problems.

Also, there was no space devoted to the effect of backmixing or to the effect of diffusion in catalyzed vapor-phase reactions.

Our purpose in the next few months will be to present a qualitative discussion of some of the problems that the chemical engineer faces in the design of catalytic chemical reactors. We'll discuss the fundamentals of catalytic vapor-phase reactions carried out in fixed-, moving- and fluidized-bed reactors; and we'll solve some problems relating to the selection and sizing of reaction vessels.

The Problems of Reactor Design

To design a chemical reactor, the chemical engineer must use a combination of mature judgment and design calculations to investigate several factors. He must ask himself these questions:

- Should the reactor be operated isothermally, adiabatically, or with addition or removal of heat?
- What is the best range of operating temperatures?
- Should the reaction take place at atmospheric pressure, high pressure or under vacuum?
- Should an inert gas be added?
- Should a fixed, moving or fluidized bed be used?
- Should the reaction be once-through with high conversion or should recycle be used?
- Will the effect of backmixing be important with this particular reaction?
- Will the catalyst need reactivation or replacement?

And if so, should a moving bed of catalyst be used?

- How will the temperature be controlled?
- How will the pressure be controlled?
- If the reaction is exothermic, should the heat of reaction be recovered?
- What type of reactor should be used? A tube, a large diameter vessel or a tower?
- What dimensions should the reactor have?

A Formidable List

This is a formidable list and, of course, there are many instances where the answers to some of these questions are available even before the problem is begun. This would be the case wherever a reactor had already been designed for the process in question or for a very similar reaction.

However, in many cases the engineer determines the answers to most of the above questions by using many trial calculations. He makes trial design calculations for a whole series of alternate conditions to select the optimum case. In the problems that we will use to illustrate these installments, we'll present only sample calculations for typical conditions.

What Preliminary Data Must He Have?

Before he can begin these design calculations

Meet Our Co-Author . . .



W. C. MILLS is a 25-yr. old Michiganiite who took his B.S. and M.S. degrees from the Univ. of Texas. At Brandenburg, Ky. he is with Olin Mathieson's development dept. In his spare time he teaches extension courses for the Univ. of Kentucky and works with little league teams. Although banks have him on record as W. Charles Mills, everyone else calls him Charlie.

the chemical engineer must have the following information on the system:

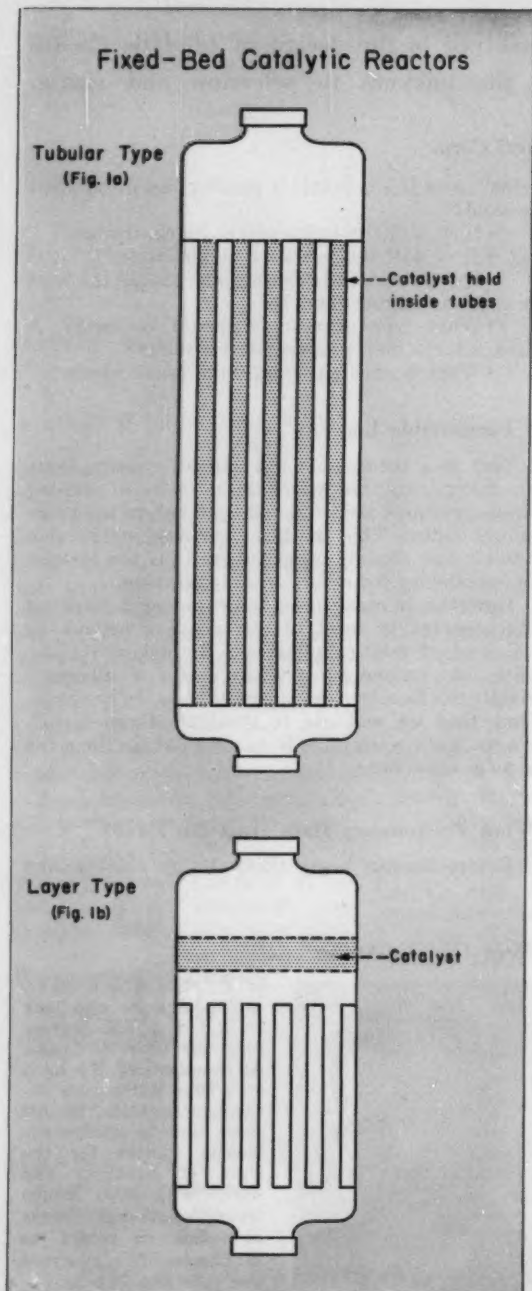
1. A kinetic rate equation that is reliable over the range of conditions involved. Either theoretical or empirical equations may be used.
2. The equilibrium constant for the reaction.
3. The variation of the rate constant, all adsorption constants and the equilibrium constant with temperature.
4. Thermal data on the heat of reaction and the

specific heats of all materials involved in the reaction.

5. Physical data on viscosities and densities of all components as a function of temperature.

In addition, the engineer must know something about the corrosiveness of the reaction system so that he can select suitable materials of construction for the reactor.

How the engineer uses these data to select the reactor type and size, will be illustrated in this and following installments.



The Basic Design Problems

In the limited space that we have available we will not be able to give worked-out examples for every problem in reactor design. However, we'll try to present sample calculations for the basic types of reactor designs. These are:

1. Design of an isothermally-operated reactor.
2. Design of an adiabatically-operated reactor for the same reaction conditions.
3. Design of an exothermic reactor with considerable transfer of heat but not at isothermal conditions.
4. A comparison of a longitudinal reactor vs. one with complete backmixing.
5. Design of a parallel-tube fluidized-bed reactor for stable operation.
6. An explanation of the modified calculation methods that are required for the case where diffusion to the catalyst has a significant effect.

The Qualitative Approach

In the past decade the chemical industry of the United States has experienced an enormous growth. A large factor contributing to this growth has been the constant vigilance of chemical engineers in applying new scientific principles to the technological problems of the chemical process industries.

Important developments of recent years include the use of catalysis and the techniques of moving- and fluidized-bed operations in promoting desired chemical reactions on a commercial scale.

Chemical engineers recognize the increasing importance of applied reaction kinetics and of fluid dynamics in formulating the basic principles of reactor design. Let's discuss briefly and in a qualitative way how some of the principles of fluid dynamics may supplement those of reaction kinetics in the solution of fluidized-reactor problems.

Fixed-Bed Reactor Most Familiar

The oldest and most familiar catalytic chemical reactor is the fixed-bed reactor. Here the catalyst particles remain in a fixed position and the reacting gases move through the catalyst bed.

The catalyst particles are usually porous pellets—either cylindrical or spherical—ranging from $\frac{1}{8}$ to $\frac{1}{2}$ inches or more in diameter. The physical structure of these pellets is usually such that the internal pore surface is infinitely greater than the actual pellet surface. Thus, the actual contact surface present is independent of pellet size.

However, the internal surface is available only through the process of diffusion which is usually relatively slow compared with the actual gas velocities through the bed. Therefore, it's desirable to use the smallest possible pellets without causing too much pressure drop through the bed.

We have illustrated two major types of fixed-bed reactors in Figs. 1a and 1b.

Longitudinal vs. Backmixing

Fixed catalyst beds may be classified roughly into longitudinal and backmixing types. Fig. 2 summarizes the characteristics of each type.

The longitudinal bed has a long, tubular shape and we assume that the gas passes through the bed in plug flow. That is, all of the gas is assumed to be going through the reactor with no transverse or eddy currents present.

In calculating the size of a longitudinal reactor by use of reaction rate equations, we consider the distance traveled by the gas along the reactor as a variable which is equivalent to contact time in the case of batch reactors.

Of course, longitudinal flow is not always attained. But it is a valuable concept which, like the ideal gas or Carnot cycle, is approached but never actually attained.

The opposite extreme of longitudinal flow is that of complete mixing within the reactor. This is the case which is approached by reactors which have a small length-to-diameter ratio.

In the reactor with complete backmixing the eddy currents are so great that the composition within the reactor is the same at all points. The gas composition within this type of reactor would be the same as the gas composition of the effluent stream. At any point in the reactor the composition would correspond to that of highest conversion.

Therefore, the reaction rate throughout the reactor would be equal to the lowest reaction rate in the corresponding longitudinal reactor. We find that there are two serious disadvantages of the complete mixing type of reactor. They are:

- For a specified conversion—especially where it is close to equilibrium conversion—the amount of catalyst and size of reactor required are much greater than in the case of the longitudinal reactor.

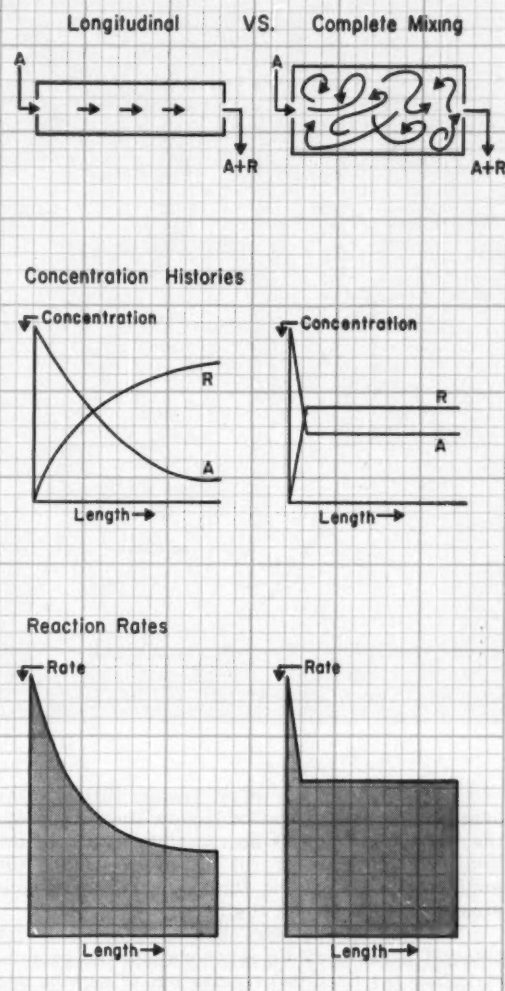
- Where the products of the reaction further decompose or enter into undesirable side reactions, the ultimate yield of desired product will not be as great as in the case of the longitudinal reactor.

In actual practice most reactors are neither completely longitudinal nor completely backmixing. They are somewhere between the two extremes. Generally, it is desirable to approach the longitudinal case as closely as possible.

Longitudinal Type Has Advantages

Fixed-bed reactors may be of either the longitudinal or the backmixing type but in most cases the longitudinal reactor is preferred because of the advantages presented above. The catalyst chamber may consist of a series of relatively long catalyst tubes operating in parallel. Since each

Characteristics of Flow Reactors

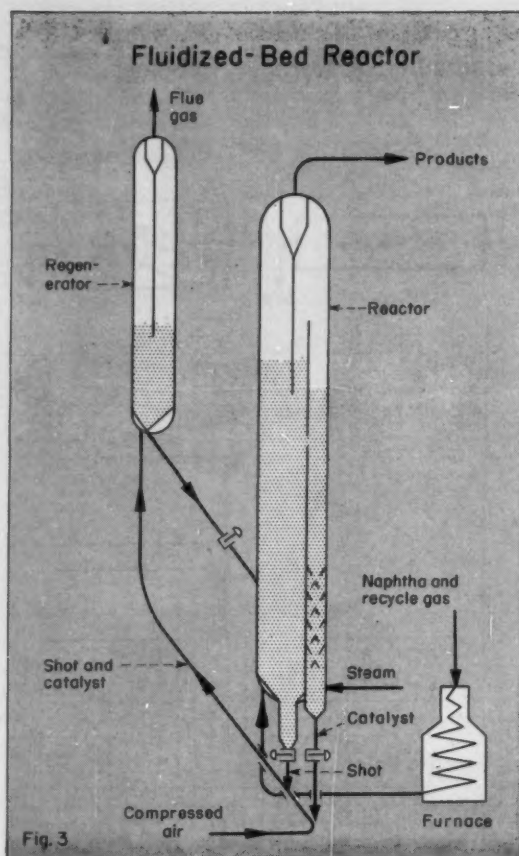


tube contains a definite measured amount of catalyst, it is relatively simple to obtain the same flow and, therefore, the same degree of conversion in each tube.

But Fixed Bed Has Its Disadvantages

There are three major disadvantages of the fixed-bed reactor. They are:

- In the case of a highly endothermic or of a highly exothermic reaction, it is difficult to transfer heat into or out of the catalyst bed fast enough to prevent large temperature gradients within the catalyst bed or even within the catalyst pellets themselves. In such cases, it is very difficult to obtain and maintain an "isothermal" bed.



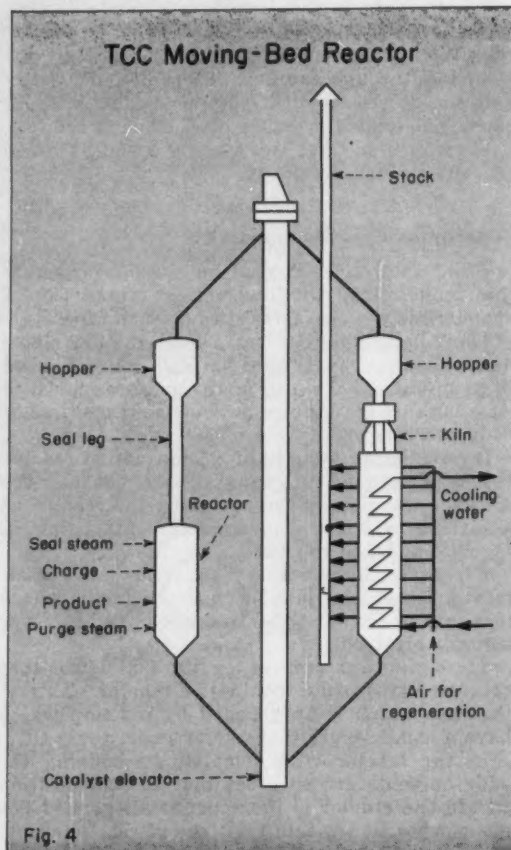
• Where the rate of diffusion through the pores of the catalyst pellet is slow compared with the reaction rate, it is not possible to utilize the total surface area of the catalyst because the minimum pellet size is limited by the allowable pressure drop through the bed.

• When the catalyst life is short and the catalyst needs periodic regeneration, the expense of taking the fixed-bed reactor out of service and of regenerating catalyst may upset the economics of the process. An example is the catalytic cracking of crude petroleum. Fixed-bed catalytic reactors can be designed for periodic regeneration but this requires a complicated design and control system.

Although the third disadvantage can be overcome by the use of a moving-bed reactor such as in the TCC and the Houdrifiow processes (see figures above and on p. 201), this does not necessarily eliminate the first two drawbacks listed above.

Fluidization Can Help

The use of a fluidized-bed reactor may eliminate all three disadvantages of a fixed-bed reactor and at the same time present other favorable features. In the fluidized-bed reactor the catalyst bed is



in the form of a fine powder which is suspended by the upward motion of the reacting gases passing through the bed. The constant motion of the catalyst particles serves to prevent any temperature gradients within the bed even where there is a large heat of reaction.

Therefore, a very close approach to an isothermal bed may be attained and local "hot spots" may be virtually eliminated. The second disadvantage of a fixed bed is eliminated because the size of the fluidized catalyst particles is extremely small compared with a fixed-bed pellet.

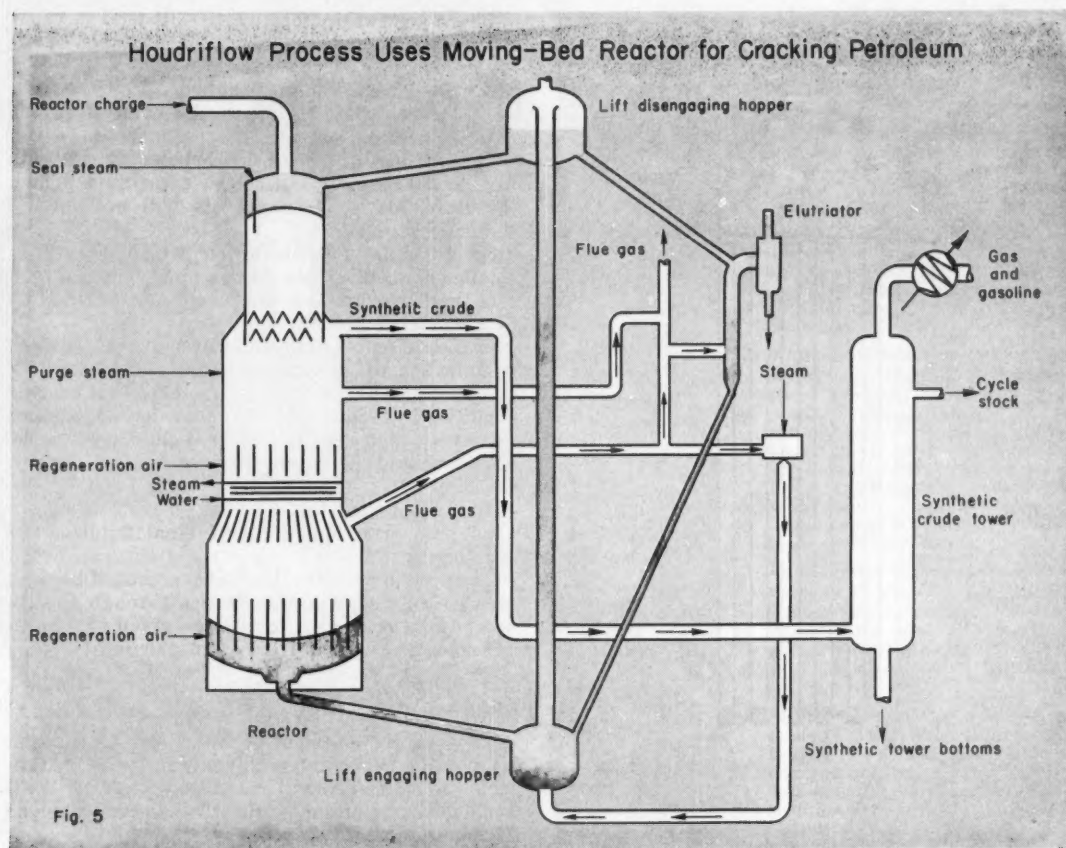
But It's Not a Panacea

The use of a fluidized catalyst may not, in all cases, be the panacea which some articles in the literature would lead us to believe. There are some disadvantages in the use of a fluidized-bed catalytic reactor, also.

For the purpose of illustration we show a typical fluidized-bed reactor in the sketch above.

Three Fluidization Difficulties

Three difficulties which may occur in fluidization are slugging, channeling and attrition of the catalyst.



Slugging is the term that is used to describe what happens when gas passes up through the bed in the form of large gas bubbles.

Channeling denotes the condition in which gas is not evenly distributed through the cross-section of the catalyst bed but is concentrated in channels through the bed.

Excessive attrition may be caused by poor flow characteristics within the bed or by the gas entering the bed in the form of jets rather than in evenly distributed flow.

Proper Design Minimizes Difficulty

The disadvantages of a fluidized-bed reactor may be minimized by the use of properly-designed reaction vessels. It seems, however, that in most cases this leads to a fluidized reactor which has a low ratio (1 to 2) of reactor height to reactor diameter.*

This low height-to-diameter ratio allows backmixing within the gas. Therefore, the fluidized bed reactor of low height-to-diameter ratio can not function as a longitudinal reactor. And this means that one of the major advantages of the fixed-bed reactors—that of longitudinal flow—is not present

in the more common types of fluidized-bed reactors. The effect of this backmixing has been evaluated by Gilliland and Mason for the case of a first-order reaction.

The Longitudinal Fluidized Bed

We have shown previously (*Chem. Eng.*, Oct. 1955, p. 214; Nov. 1955, p. 217; and Dec. 1955, p. 211) the great effect that backmixing has on the required holding time in a reactor, especially at high conversions.

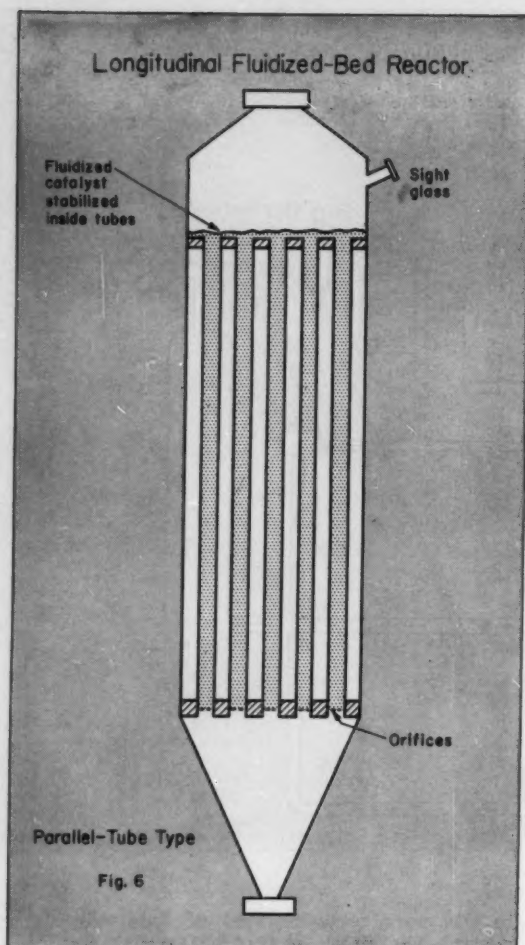
Therefore, it would seem that there is a certain type of reaction which can not be carried out in a fluidized-bed reactor because of the backmixing effect that fluidization causes. If we wanted to carry out such a reaction in a fluidized-bed reactor at all, we would have to use a longitudinal fluidized bed for our reaction zone.

There are only two types of longitudinal homogeneous reactors: a long tubular coil and a bundle of short tubes operating in parallel.

The long single coil is not suitable for either a fixed- or fluidized-bed catalytic reaction. Therefore, the type of longitudinal reactor used in catalysis is the tube bundle type.

In the case of a fixed catalyst bed longitudinal reactor, each tube is packed with a definite amount

* Gilliland, E. R. and E. A. Mason, "Gas and Solid Mixing in Fluidized Beds," *Ind. & Eng. Chem.*, p. 1,191 (1949).



of catalyst and the gas is passed either upward or downward through the catalyst tubes. The comparable setup for a longitudinal fluidized bed is more complicated.

In Fig. 6, above, we have shown a longitudinal fluidized-bed reactor. This reactor has long parallel tubes that are filled with a fluidized catalyst. The passage of catalyst through the tubes is stabilized by an orifice at the bottom of each catalyst tube.

Design for Longitudinal Fluidization

To design a longitudinal fluidized-bed reactor we would first calculate the required W/F value. (Where W is the mass of the catalyst and F is the feed rate.) For this calculation we would use conventional methods. We plan to illustrate these methods by the use of worked-out sample problems in the upcoming installments.

However, there is more to the design than just obtaining the W/F value. Stable operation must be assured.

There are two factors which will tend to cause the operation of a reactor to be unstable. They are:

- Slugging of the catalyst bed.
- Uneven distribution of the catalyst in the tubes.

If slugging occurs, large bubbles of gas will pass up through the fluidized catalyst bed and, therefore, all of the reactants will not contact the catalyst.

Slugging is a phenomenon which occurs in smaller diameter tubes. It is a phenomenon which sets the lower limit on the tube diameter that can be used in the reactor.

The minimum diameter for a given system usually has to be determined in a laboratory or pre-pilot plant setup simulating the actual process conditions. This is not an undue hardship since processes that use longitudinal fluidized-bed reactors should be taken through the pilot plant first anyway.

We recommend this because so little is known about the operation of longitudinal fluidized-bed reactors.

The second problem listed above, that of keeping an even flow distribution of gas through the reactor tubes is one that should be given very careful consideration in any design calculation.

Coming Next Month

Because the problem of even gas distribution is such an important problem, our entire installment next month will be devoted to it. We'll consider some of the qualitative aspects involved in the problem.

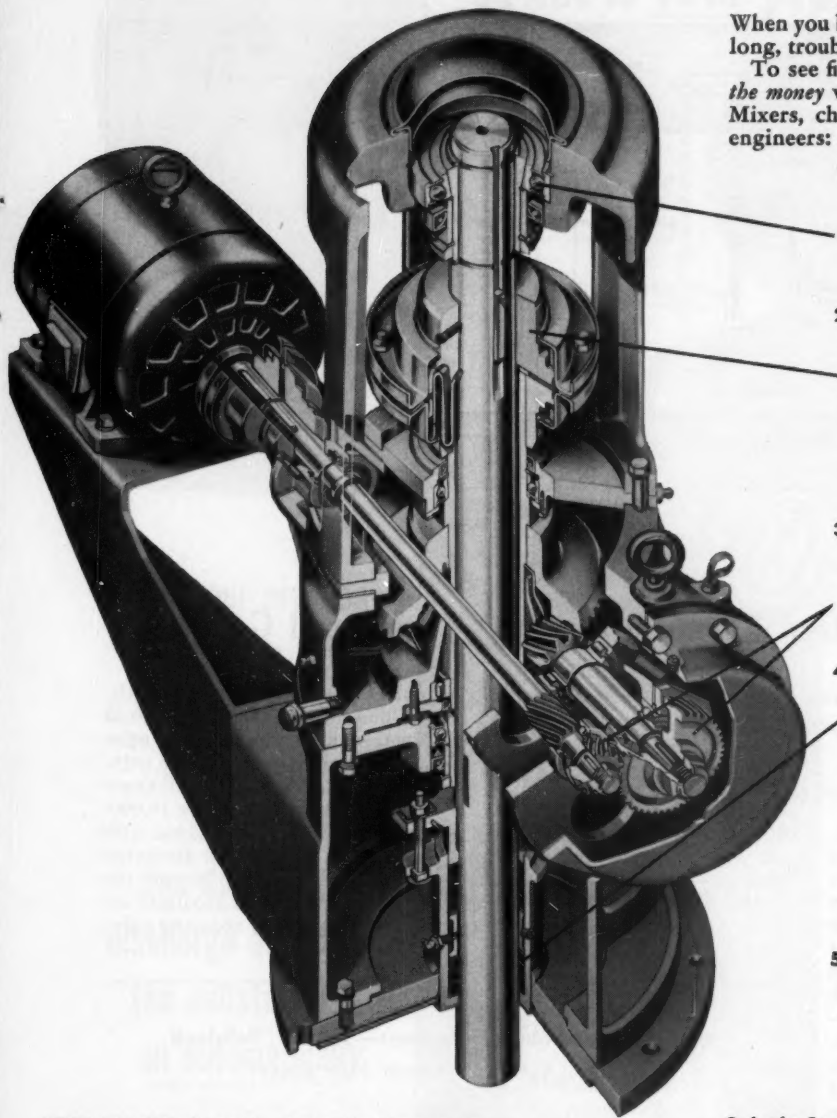
However, before we can get into the complications of parallel flow through many tubes we will first review the effect of gas flow through a single tube. We'll consider the case of long tubes with no overflow and discuss the types of parallel tube fluidized reactors. Also, we'll consider the effect of velocity on pressure drop, explain how orifices stabilize the operation and how to calculate orifice size.

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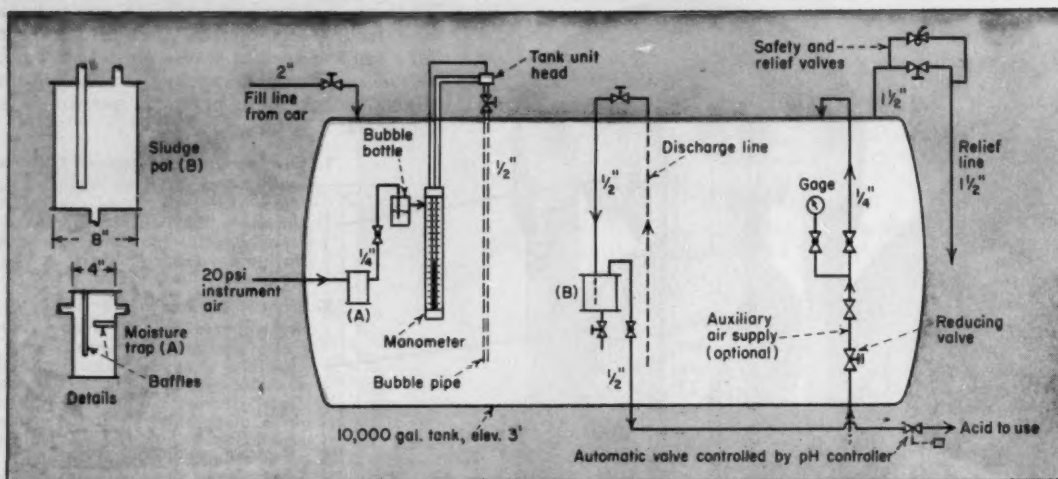
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Plant Notebook

EDITED BY T. R. OLIVE



★ Winner of January Contest

Acid Tank Pressurized Through Bubbler Type Level Gage

Acid treating installation improved by pressurizing acid tank with air, discharging acid through controlled valve.

Jorge E. Burguet

Dept. of Engineering, Mississippi Power & Light Co., Jackson, Miss.

We have the problem of feeding concentrated sulfuric acid under control of a pH meter into the circulating water of a large power plant. The purpose is to control alkalinity and consequent delignification of our redwood cooling towers. Following much trouble with the use of proportioning pumps, we hit on a simple variation of the old air displacement method which operates very satisfactorily, enabling us to hold the water at pH 7.2, with a variation of no more than 0.2 pH units.

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high enough to push acid through the discharge line and an automatically controlled valve (controlled from a pH meter), to the point of acid use. Acid flow re-

quirements are generally small: in one installation, about 0.03 gpm., and in another, 0.15 gpm.

The drawing shows the principal features of this arrangement. Acid is stored in a 10,000-gal. tank which is provided with a 2-in. fill line; a 1/2-in. discharge line from a point 8 in. off the tank bottom; a 1/4-in. auxiliary air line with a 15-psi. reducing valve

★ Winner of February Contest—John T. Selldorff

"Control Valves for Narrow Flow Range"

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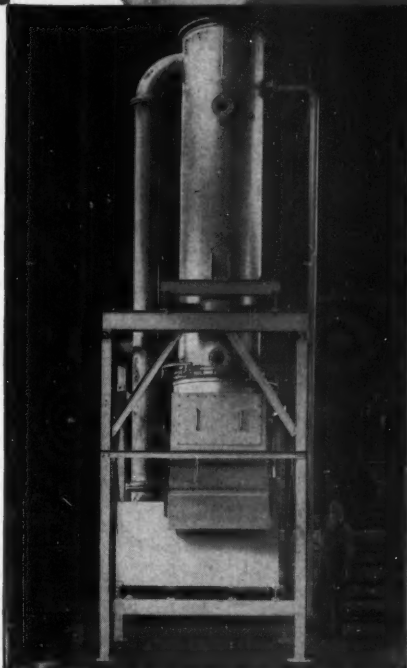
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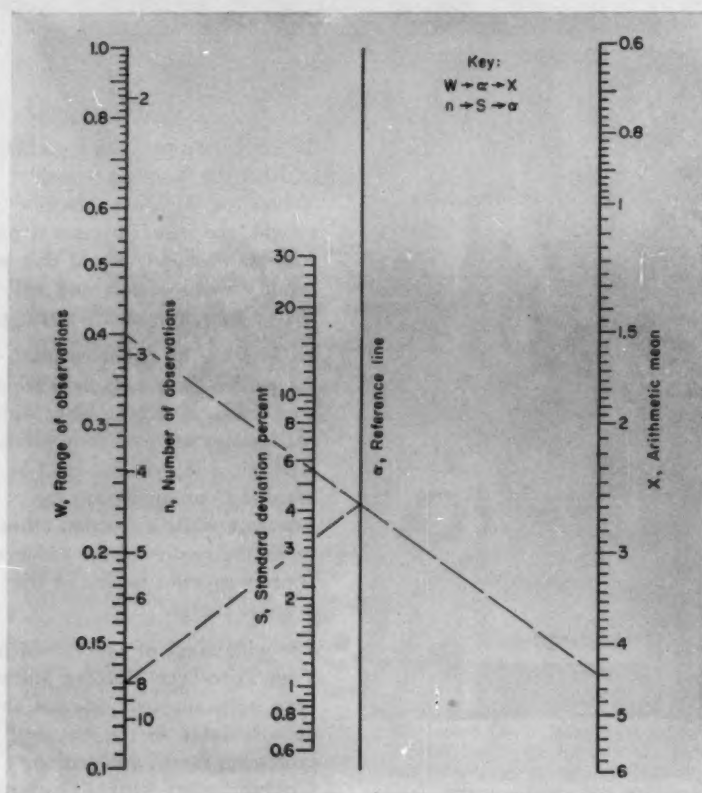
for optional manual pressurizing; and a 1½-in. pressure relief line containing in parallel a safety valve set at 25-30 psig., and a manual relief valve. In addition, the tank is provided with a bubble-pipe type of liquid level gage which is read on a manometer. The manometer is valved off from the tank when using the auxiliary air to prevent the possibility of blowing acid back into the manometer.

The level gage tank unit is connected to the manometer unit by three plastic pipes, one to

bring the incoming air to the head of the tank unit, one to bring the static pressure in the ½-in. bubble pipe to one leg of the manometer, the third to equalize the tank pressure with the other leg of the manometer. Thus the measurement shown by the manometer is proportional to the actual depth of liquid in the tank above the bottom of the bubble pipe.

Instrument air at 20 psig. passes first through a small moisture trap made of a piece of 4-in. pipe. It then flows through

a bubble bottle to permit adjusting the air flow rate, and into the level gage drop pipe. Because of the small flow of acid required, acid consumption is almost negligible. Acid discharges through a small sludge pot made of a piece of 8-in. pipe to protect the subsequent automatically controlled valve against possible sludge carry-over from the tank. This valve is a ½-in. single-seated control valve with an approximate equal-percentage characteristic, made with Hastelloy B body and trim.



Shortcut Chart for Standard Deviations

Dale S. Davis

Professor of Chemical Engineering, Virginia Polytechnic Institute, Blacksburg, Va.

Chemical engineers often neglect to apply elaborate statistical treatment to their test data because they cannot spare the

time and because the usual procedures are not suitable for small numbers of observations. However, shortcut methods^{1,2,3} that

require relatively little computation are now available for situations where the number of observations is small.

Calculation is further facilitated by means of the accompanying nomograph, which was constructed through application of methods previously described. The chart solves the following equation

$$S = 100 KW/X$$

where S = standard deviation, percent; K = deviation factor, which is a function of the number of observations n as defined by the table:

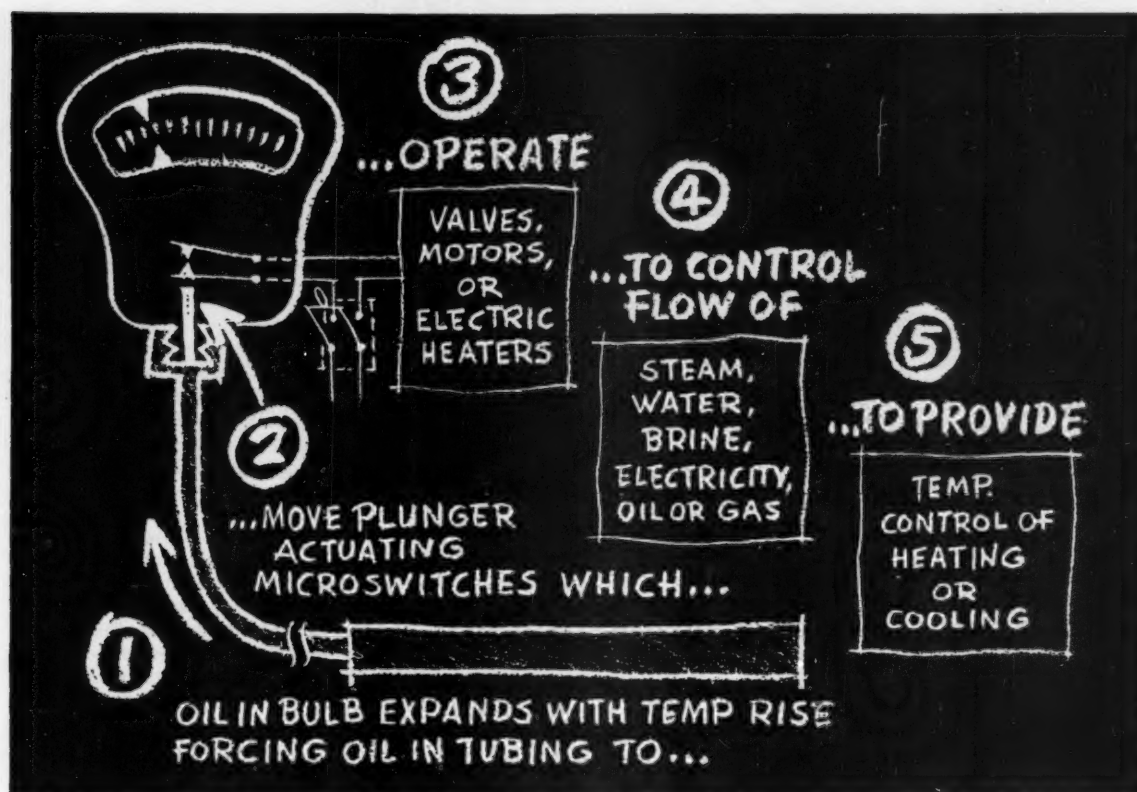
n	K	n	K	n	K
2	0.89	5	0.43	8	0.35
3	0.59	6	0.40	9	0.34
4	0.49	7	0.37	10	0.33

W = range of observations (difference between the high and low values); and X = arithmetic mean.

The use of the nomograph is illustrated as follows: What is the standard deviation when the range of eight observations is 0.40 and the arithmetic mean is 4.4? Following the key, connect 0.40 on the W scale with 4.4 on the X scale and note the intersection with the a axis. Connect this point with 8 on the n scale and read the desired standard deviation on the S scale as 3.2%.

REFERENCES

1. Dean, R. B., and W. J. Dixon, *Anal. Chem.*, 23, 636 (1951).
2. Dixon, W. J., and F. J. Massey, "Introduction to Statistical Analysis," p. 239, McGraw-Hill Book Co., New York, 1951.
3. Reitz, L. K., A. S. O'Brien, and T. L. Davis, *Anal. Chem.*, 22, 1470 (1950).



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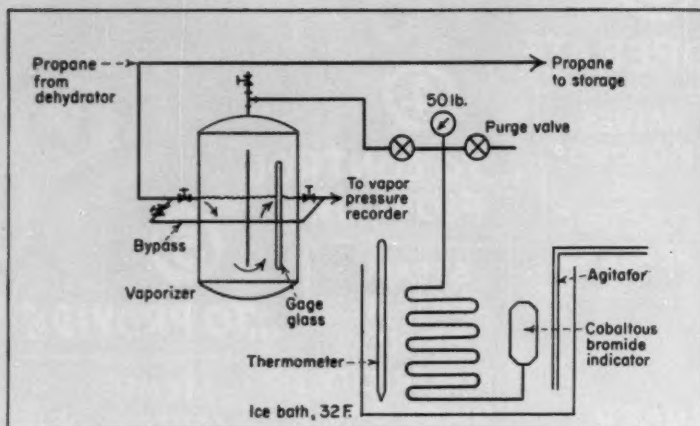
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Installing a Propane Dryness Indicator

Luis G. Vazquez

Chemical Engineer, Natural Gasoline Plants, International Petroleum Co., Ltd., Talara, Peru.

Finding the proper location for a cobaltous bromide tester for the continuous indication of liquid propane dryness is not an easy task. This instrument is specified by the Natural Gasoline Association of America (NGAA), and it is recommended that it be taken into the field and connected directly to the sample source whenever possible.

A convenient place for it in a natural gasoline distillation plant is to locate it in the small building for the vapor pressure recorder, right among the towers used for controlling the product specifications. It is generally easy to find room and install the apparatus in this sheltered spot.

Vapor for the dryness indicator should be taken off from a small vaporizing chamber which can be installed in the bypass line to the vapor pressure recorder. This can be as small as 3 liquid gal., plus 30% vapor space, with a diameter close to its length, or about 10 in. I.D. x 12 in. long. Although the NGAA has specified 15 to 20-gal. samples, it is possible to get a sensitive test with 3 gal.

The vaporizer should have inlet and outlet connections on the same level, and an internal partition to force liquid flow through the bottom of the vessel. Vapor above the liquid must be in equi-

librium with the liquid itself to insure the same proportion of water in each phase. A $\frac{1}{4}$ -in. line from the top of the vaporizer carries vapor to the dryness tester.

The vaporizer should have a sight gage glass and valves for regulating flow to hold a constant level. Evolution of vapor from the liquid propane upsets the vapor pressure to some extent, so it is better to use a separate stream to the vapor pressure recorder, for example, the indicated bypass line, and to operate with the vaporizer outlet closed.

The cobaltous bromide tester itself is made according to the NGAA specifications and arranged as in the sketch. The second valve shown at the inlet connection is for purging the line when starting up. The usual cooling arrangement is an ice-and-water bath to cool the coil to 32 F. If automatic cooling is preferred, a liquid-oil bath can be substituted, with a propane expanding line passing through it and some simple thermostatic control device added to regulate the refrigerant and hold the temperature at the recommended value.

In operation, change of the cobaltous bromide sample from green or blue, to lavender or pink, will be reported as "wet."

Estimating Steam Film Coefficients Under Vacuum

Liang-tseng Fan

Dept. of Chemical Engineering, West Virginia University, Morgantown, W. Va.

The problem of estimating the condensing film heat-transfer coefficient for steam condensing at pressures less than atmospheric is often encountered in the process industries. Exhaust steam from turbines, and water vapor from vacuum dryers and stills, are nearly always condensed below atmospheric pressure.

The condensing film heat-transfer coefficients for vapors condensing on the outside of tubes, as is most often the case in practice, can be estimated by the following equation which is presented in most standard references on heat transfer.

$$h_m = 1.5 \phi_f (4 G / \mu_f)^{-1/4} \quad (1)$$

where $\phi_f = (k_f^3 \rho_f^2 g / \mu_f^2)^{1/4}$

and $G = W/L N_i$ (for horizontal tubes)

or $G = W/\pi D_o N_i$ (for vertical tubes)

The use of this equation requires a knowledge of the temperature of the condensate film as well as the corresponding values of thermal conductivity, viscosity, and density. A simplified equation is available for steam but is valid only at atmospheric pressure.

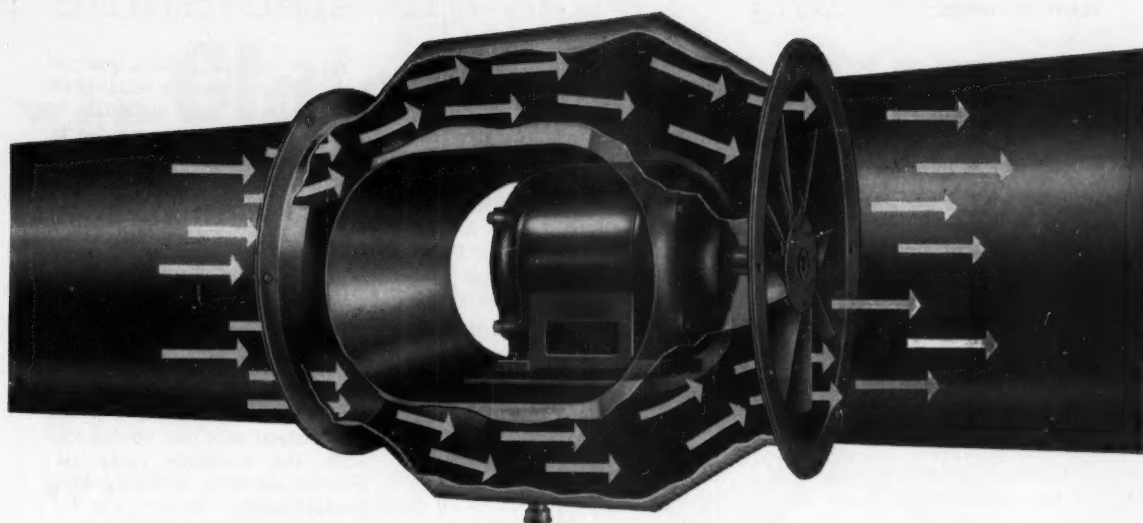
The writer has found that ϕ_f and μ_f of steam below atmos-

Nomenclature

- D_o Outside diameter of tube, ft.
- G Condensing load, lb./hr. (lin. ft.)
- g Acceleration due to gravity, ft./hr. (hr.)
- h_m Mean value of heat-transfer coefficient of condensate film, Btu./hr. (sq. ft.) (°F.)
- k_f Thermal conductivity of condensate at t_f , Btu./hr. (sq. ft.) (°F.)
- L Length of tube, ft.
- N_i Number of tubes
- t_f Temperature of condensate film, °F.
- W Condensing rate, lb./hr.
- ϕ_f A dimensionless group,

$$\left(\frac{k_f^3 \rho_f^2 g}{\mu_f^2} \right)^{1/4}$$

- μ_f Absolute viscosity of condensate at t_f , lb./hr. (ft.)
- ρ_f Density of condensate at t_f , lb./cu. ft.

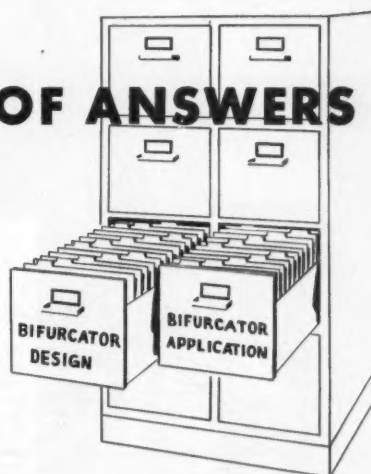


The DeBothezat Bifurcator is a direct-driven fan in a divided housing. Fumes bypass the motor which always stays clean, cool and accessible. Installs like a section of duct-work . . . vertically, horizontally or at any angle.

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pheric pressure can be closely approximated by the following empirical equations:

$$\phi_f = 550 + 25t_f \quad (2)$$

$$\mu_f = 0.1 + 150/t_f \quad (3)$$

where t_f is the temperature of the condensate film.

With the aid of the above relationships, it is possible to estimate the condensing film heat transfer coefficient for steam condensing under vacuum, knowing only the temperature of the condensate film and the condensing load. Thus, the calculation is greatly simplified. The following example illustrates the method.

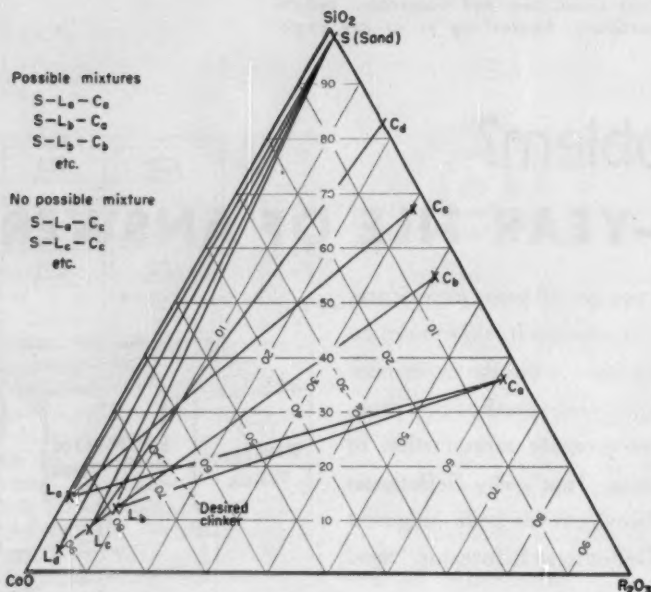
Example—Steam is condensed at the rate of 1,600 lb./hr. out-

side a $\frac{1}{2}$ -in. horizontal tube 16 ft. long. The temperature of condensate film is known to be 100F. Estimate the heat-transfer coefficient of condensate film.

Solution—The condensing load $G = 1,600/16 = 100$. Then, from Eqs. (2) and (3), $\phi_f = 550 + 25(100) = 3,050$; and $\mu_f = 0.1 + 150/100 = 1.60$. Substitution of these values into Eq. (1) yields

$$h_m = 1.5 (3,050) (4 \times 100 / 1.6)^{-1/4} = 726$$

Solving the original equation with $G = 100$, $\mu_f = 1.66$, $k_f = 0.363$, $p_f = 62.0$ and $g = 4.17 \times 10^8$ gives $h_m = 731$, which deviates less than 1% from the value of 726 found by the short method.



Graph Solves Three-Component Mixtures

Arturo Vera, Jr.

Chief Chemist, Puerto Rico Cement Corp., San Juan, P. R.

When dealing with mixtures of three components, the triangular chart is a handy graphical device which can save tedious calculation. It can be used where the mixture is to be made from three materials such as ores or minerals, each of which contains various proportions of the three wanted compounds.

Its use depends upon the well-

known property of the equilateral triangle in which the sum of the perpendiculars from any point in the triangle to the adjacent sides is equal to the altitude of the triangle. If the point represents the desired composition and the altitudes represent percentages of the three components (each apex being 100% of that component), their sum is 100%.

As an example, take a quarrying operation where a mixture of three different raw materials in definite proportions is needed to form a specified mix. In making cement, limestone, clay and sand are proportioned together to form a desired raw mix which is subsequently calcined to a clinker. However, quarry materials are not uniform, different sections yielding dissimilar limestones and clays.

This being the case, it is desirable to have a rapid method for determining, first, whether the desired mix can be reached with the available materials; and second, if so, by using what proportions?

Given the tabulated information for composition (on the ignited basis) for four limestones from the limestone quarry, and four clays from the clay pit, find out which mixtures with sand (99.0% SiO₂, 1.0% R₂O₃, ignited basis) will produce a clinker of 22.5% SiO₂, 9.9% R₂O₃, and 67.6% CaO, ignited basis.

Limestones, Ignited Basis

	L _a	L _b	L _c	L _d
SiO ₂	13.8	11.7	6.9	3.4
R ₂ O ₃	0.0	8.9	7.0	3.4
CaO.....	86.2	79.4	86.1	93.2
	100.0	100.0	100.0	100.0

Clays, Ignited Basis

	C _a	C _b	C _c	C _d
SiO ₂	35.3	54.3	67.1	82.2
R ₂ O ₃	61.2	40.7	30.5	17.8
CaO.....	3.5	5.0	2.4	0.0
	100.0	100.0	100.0	100.0

Compositions for the desired clinker and the nine available raw materials are plotted on the triangular chart. Then in turn connect S (for sand) with each of the limestones (L_a, L_b, L_c, and L_d) and connect each of these in turn with the four clays (C_a, C_b, C_c, and C_d) to form a total of 16 triangles. Only a few of these are shown on the chart to avoid confusion.

Any of these triangles which encloses the composition of the desired clinker represents a possible combination of the raw materials. (For example, S-L_a-C_a, S-L_b-C_a, S-L_b-C_b, S-L_b-C_c, S-L_b-C_d, S-L_c-C_a, S-L_c-C_b, S-L_c-C_c, S-L_c-C_d, S-L_d-C_a, S-L_d-C_b, S-L_d-C_c, S-L_d-C_d.) Any triangle which does not enclose the desired clinker composition does not represent a possible combination. (For example, S-L_a-C_b, S-L_a-C_c, S-L_a-C_d, S-L_b-C_a, S-L_c-C_a, S-L_c-C_b, S-L_c-C_c, S-L_c-C_d, S-L_d-C_a, S-L_d-C_b, S-L_d-C_c, S-L_d-C_d.)

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These glass-lined vessels assure freedom from contamination . . flexibility of use . . . shorter drying cycles . . . uniformity of product . . . elimination of handling and sticking losses

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Standard glass-lined Dryer-Blenders are built in the following capacities — 5 to 35 cu. ft. and larger on request; operating temperatures — liner 500° F, Jacket 650° F; operating pressures — tank full vacuum to 25 psi, jacket 65-75 psi (50-60 psi with tank at full vacuum). Acid or acid-alkali glass-linings are available. Complete specifications available on request.

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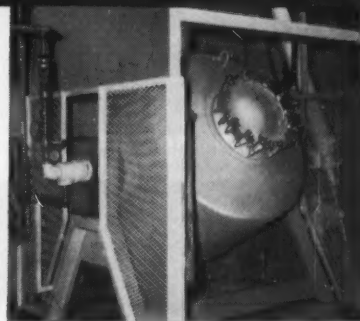
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Installed at the Chicago Heights, Ill., plant of the Victor Chemical Company, this Glascote conical, rotary Dryer-Blender makes possible uniform, short-cycle drying of several materials which couldn't be dried in any other way.



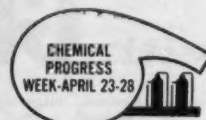
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Life

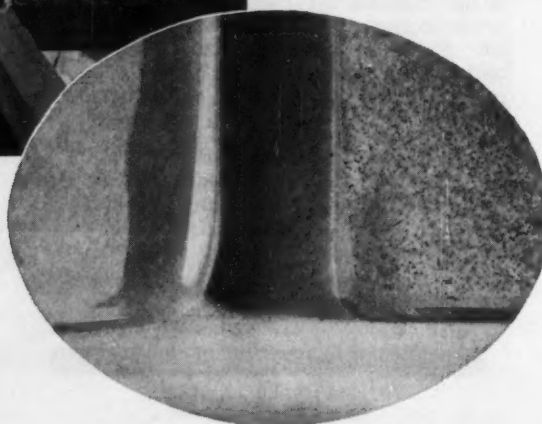
on the Chemical Newsfront



A BETTER AMERICA
THROUGH CHEMICAL PROGRESS



MOLTEN METAL SPECKS BOUNCE OFF NEW PLASTIC, HT-CR-39 polymer (left), made exceptionally heat and abrasion resistant by Cyanamid's triallyl cyanurate. The sparks leave the plastic surface unmarred (inset, left) but fuse to glass (inset, right). Developed by Cast Optics Corp., Hackensack, N. J., HT-CR-39 rivals optical glass in clarity. It remains flat and rigid even at 230° F, where acrylics become fluid. By the Taber test, it is 35 to 45 times as abrasion resistant as the acrylics. Triallyl cyanurate, a new chemical combining three allyl groups with the exceptionally stable triazine nucleus, confers to a wide variety of resins a high heat distortion point, high temperature stability, stable electrical properties and high resistance to solvents, chemicals and fire. (New Product Development Department, Section 2)



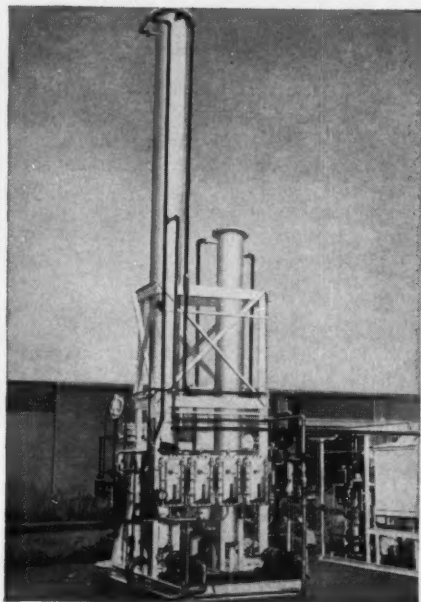
LOADING COSTS HAVE BEEN CUT as much as 50%, and unloading costs as much as 75% by the use of ACCOPAK® Paper Pallets over a year-long test period in Cyanamid and customer plants. In handling a flaked chemical in multiwall bags, loading cost was reduced from \$27.80 per car to \$17.77. The receiving plant reported that unloading costs fell from \$22.86 to \$4.06. Labor savings are dramatic: in another case, loading time was cut from 12 to 6.8 man-hours, unloading time from 8 to 1.2 man-hours. With this pallet, a kraft paper sling between two spiral-wound paper tubes, unitized loads can be tiered without use of space-wasting platforms. Crush-resistant tubes allow easy re-entry of lift truck bayonet forks without damage to adjacent bags. Today, ACCOPAK Pallets are available to plants handling bagged materials. (Industrial Chemicals Division)



NEW COSMETICS AND PHARMACEUTICALS based on AERO® Glycolonitrile are joining other fine products in medicine cabinet and vanity. Of particular interest are N-substituted sarcosinates, surfactants which provide antienzyme action, make an excellent shampoo base, provide dispersion and wetting in aerosol formulations, shaving creams and synthetic bar soaps. Glycolonitrile also is a valuable intermediate in making calcium and iron sequestrants. N-methylglycine, another derivative of glycolonitrile, is used as a stabilizer for diazo compounds, which are intermediates in dye manufacture. A new bulletin on properties and applications of glycolonitrile will be sent on request. (Industrial Chemicals Div., Dept. E)



BIGGEST REINFORCED PLASTIC BOAT TAKES SHAPE. A revolutionary new method was used to construct the 42-foot ketch *Arpege*, destined for a two-year scientific voyage in the South Pacific. Biggest sailboat ever made with reinforced plastic hull, it was built without permanent mold or expensive tooling. A thin inner shell of mahogany veneer, shaped over conventional hull forms, was covered with Fiberglass cloth and a specially compounded mixture of LAMINAC® Polyester Resins. A minimum of 19 layers was applied, with 30 layers in the keel sections. Several final coats of pigmented resin completed the job. Stronger than steel, pound for pound, the hull is impervious to marine borers, rot and warping, and is relatively unaffected by the elements. (Plastics and Resins Division)




NOW HYDROGEN GENERATORS COME "PACKAGED"! This generator was designed, fabricated, pretested and shipped as a unit within four months after the contract was awarded to Chemical Construction Corporation, a subsidiary of Cyanamid. Two weeks after start-up, the generator exceeded performance guarantees—55,000 SCFD of gas with a purity of over 98% hydrogen. CHEMICO produces "packaged" hydrogen generators of this type in various capacities to produce hydrogen as needed by the chemical, metallurgical and petrochemical processing industries. (Chemical Construction Corp.)



NOW SOIL GETS A "SHOT IN THE ARM"! To meet growing demands for liquid fertilizers that can be injected directly into the soil, Cyanamid has introduced its new AMANOL® Nitrogen Solutions. Applied when plowing, disking or cultivating (eliminating an extra step), solutions are injected 4 inches below the surface to prevent escape of ammonia into the air. This ammonia becomes fixed on soil particles and is released slowly for long feeding, right in the feeding zone. These solutions may also be metered into irrigation water for use in flood-type irrigation systems. (Agricultural Chemicals Division)

*Trademark

Additional information may be obtained by writing on your letterhead to the Division of American Cyanamid Company indicated in the captions.



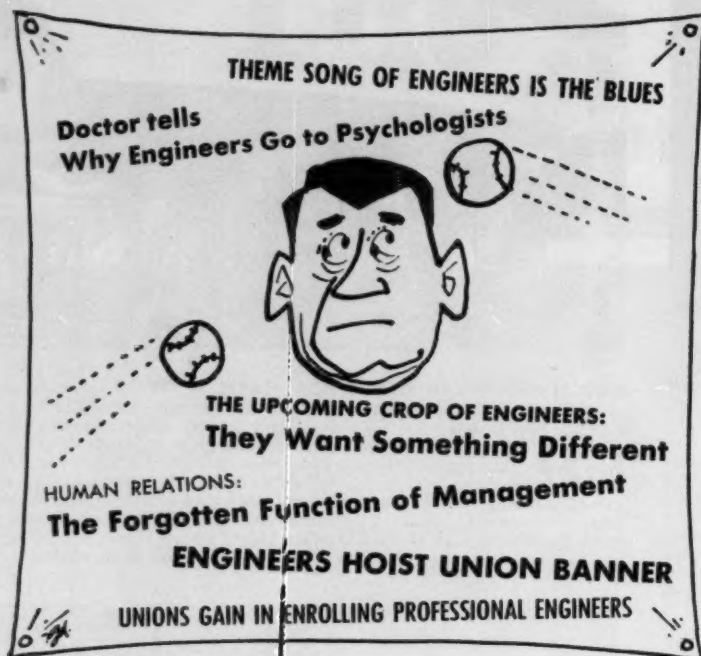
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You and Your Job

EDITED BY H. T. SHARP



HERE'S HOW

You Could Be Treated Better

EVERYBODY WINS. With the program described here troubled headlines like the above can be erased and both you and your company can profit.

Herbert R. Northrup, Penn-Texas Corp.

Success of the engineering unions and the concern they have caused people in management and the professional societies is but one symptom the discontent brewing among engineers. Salary inequities, recruiting and hiring prac-

tices, poor use of trained men, lack of status and recognition—all are current sore spots. They are results of poor administration now intensified by "the engineering crisis."

This engineering crisis results from a desperate under-supply of talent. Twenty years ago, the Bureau of Labor Statistics found that 10% of all engineers were unemployed, and about twice as many were performing non-professional work. Today, not only do we face a serious shortage of engineers, but, assuming the prognosticators are more accurate than they were when they advised college men to stay out of engineering, we may expect

that we shall be short of engineers for at least the next decade.

And, if ordinary engineers are in short supply, experts in special lines and heavily experienced personnel are almost unavailable through ordinary channels.

It follows, therefore, that personnel administration for engineers must be geared, not only as a tool for getting engineers and then keeping them happy once they're on the payroll, but also—and much more important—as a means for maximum use of the engineers who are on the job.

Proper Selection Comes First

Personnel administration for the engineer, as for any other employee begins with proper selection.

No matter whether skills are in short supply or not, a square peg doesn't fit into a round hole. Employment of people unqualified for the job not only leads to bad workmanship, but, more important, to bad morale throughout the shop. No effective worker likes to see an unqualified person working next to him with the same title and presumably a comparable salary.

Few things lead to more turnover among engineers than the wholesale hiring of inadequate personnel—unless it's the phony promises made to engineers by over-eager and under-scrupulous recruiters.

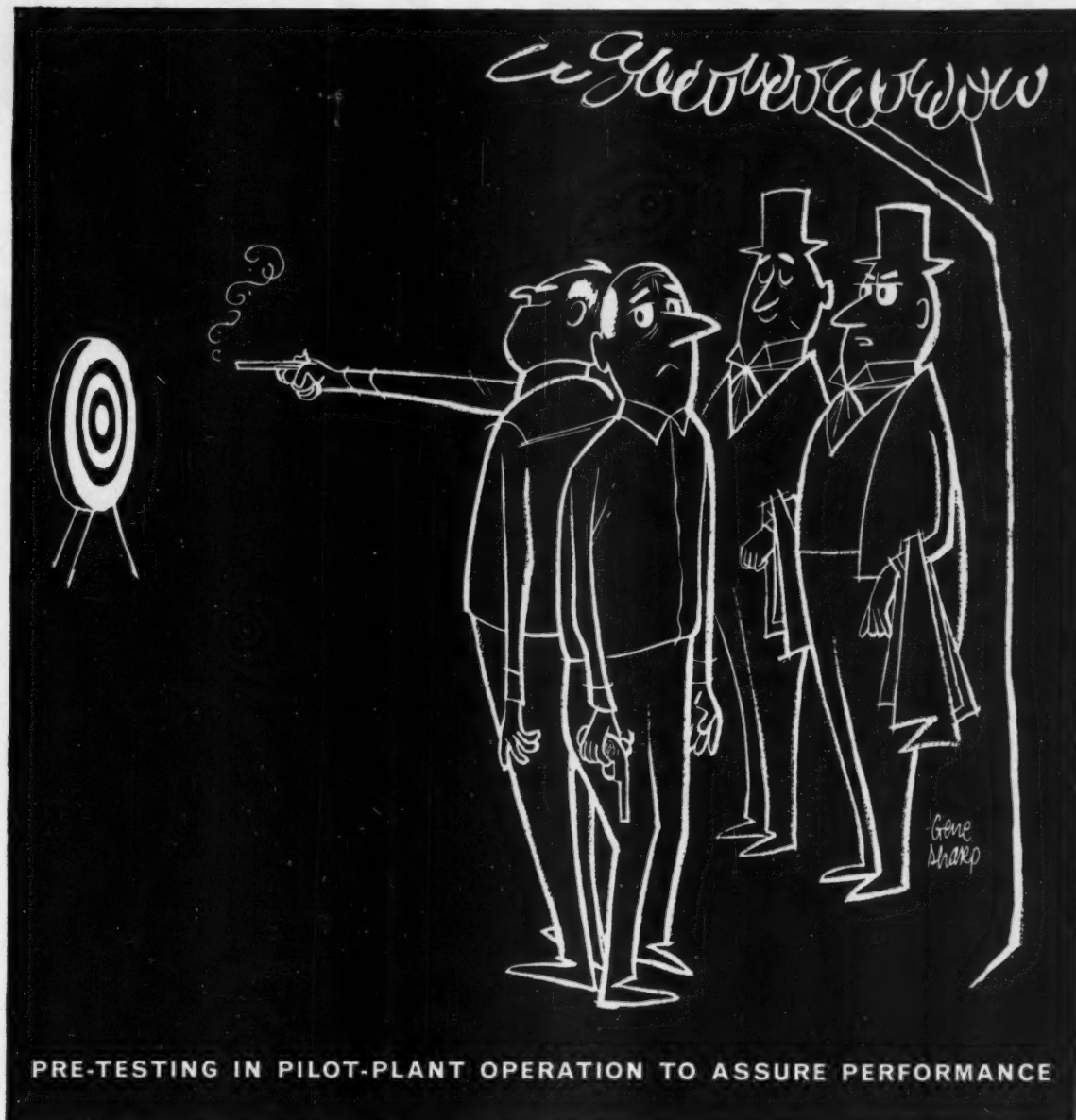
Recruiting vs. Pirating

Check your Sunday papers. You will be amazed at promises made to prospects. Why, Southern California airplane manufacturers even promise sunshine! I guess they figure that by the time you get to Los Angeles the smog will disappear and every one will bask happily in sunshine ever after.

Of course, the East cannot claim to be too holy about this thing. I understand that plants out on Long Island, or even in New England, promise good commuting to any engineer joining their force—not to mention a top salary, free time to pursue a course of his liking, a dream cottage and a ride on the first rocket to the moon.

HERBERT R. NORTHRUP has only recently been named vice president, industrial relations, of Penn-Texas. He was formerly senior industrial relations consultant for Ebasco Services. Author of many articles and three books, Mr. Northrup originally described the program he discusses here to the National Industrial Conference Board at its New York meeting, Jan. 20, 1956.

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After the engineer takes a ride on the Long Island Railroad, or gets stranded on the New Haven and trips to the moon remain pie in the sky, disillusionment can be pretty strong.

Joke about this fantastic advertising as we may, it is still only high class piracy—and sometimes not too high class at that. It creates problems for the company from which the engineer is pirated, and it doesn't give the pirated engineer or any of his new colleagues much confidence in the promises of a company whose recruiting methods are short-sighted at best and lacking integrity at worst.

College Man vs. Older Man

While we are on the subject of recruiting, let me say a word about college recruitment. It appears now that any engineering student who does not have a job by his junior year is likely to be a social outcast. By graduation time, he may have had two salary increases and a paid-up pension plan. If he hasn't been this successful, there's probably a recruiter who will promise it and more.

In the meantime, the engineer who had the misfortune to go to work five or ten years ago may be plodding along, getting himself an increase whenever the local union has won one for the rank and file.

To say that this is a situation requiring the attention of management is probably the understatement of the year.

Salary Inequities Hurt

I suggest that management should spend as much effort on holding the engineers it has as it does on getting new ones. And one of the first things that requires attention is the salary schedule for men on the job over five years. Starting rates have climbed considerably faster than the salaries of engineers who have stayed on the job. Yet, experience is something no college can hand out with a B.S. degree.

There is an old adage in industrial relations: People are more concerned about what the other fellow is paid than what they get themselves. And with starting rates much too close to rates paid for experience, this

leads to dissatisfaction and turnover.

The newly-recruited engineer finds that this salary is so close to that of his superior that he cannot get ahead except at a

The engineer finds that he is close to the bottom of the salary scale considering the work he does. For almost three generations, engineers have been waiting for the professional engineering societies to make even a gesture in their behalf, but meetings of these groups seldom make any reference to the economic status of this wage-earning class of members.

George Meany, President
AFL-CIO

painfully slow pace. And, when the experienced men find out what the recruits are paid, they begin to read the want ads with renewed interest.

Developing a Constructive Program

All of this has been more in the nature of caustic comments on present practice than a constructive program for the future. But I believe a constructive program can be developed and operated despite the aggravations of the current engineer shortage.

I believe also that the development and operation of this program is a fundamental responsibility of management.

Not a Job for Unions

The approach of the various engineer unions is, at best, a constructive irritant. The unions' role among professional employees is, and promises to be for many years to come, a minor one. Most so-called unionized "engineers" are actually draftsmen or others of less than professional rank. Since the very idea of professionalism is fundamentally eulogistic, and since unions by their propaganda and actions emphasize (and indeed appear to believe) that "after all, we are all workers," I don't look for any marked increase in their ranks.

Nevertheless, the existence of

unions ready and able to take action on the basis of discontent should warn management—if management isn't already convinced by the shortage—that "business as usual" toward engineers can greatly add to the complexity of the problem.

Not a Job for the Societies

Because the professional societies are managed by people drawn from the professions, who are conversant with professional ideals, practices and aspirations, most managements would probably prefer to deal with them rather than with unions—if a choice must be made.

Yet with all due regard to the outstanding accomplishments of the great engineering societies, management cannot rely on these organizations to supply a competent personnel program. Interest of the societies in the problems of the employed engineers—as contrasted with the self-employed one—dates largely from the depression and the entrance of the unions into the engineering field.

At least until recently the societies' approach has been defensive in character, concentrating on securing separate bargaining units for groups of engineers

Professionalism is a phony set up by big business.

James B. Carey, Vice President
AFL-CIO

threatened with being engulfed by industrial unions. Although the societies have widened their horizons in the personnel field, they simply aren't equipped to do the job for the engineer-employee which must be done today, and which only good management can satisfactorily accomplish.

Basics of the Program

The program which I advocate has as its basic philosophy the premise that engineering and other professional employees should be treated both as

• Members of the management organization.

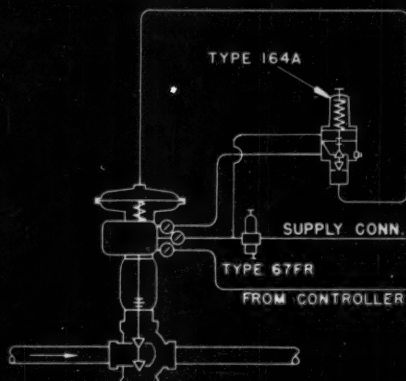
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For "Gadgeteering" Control

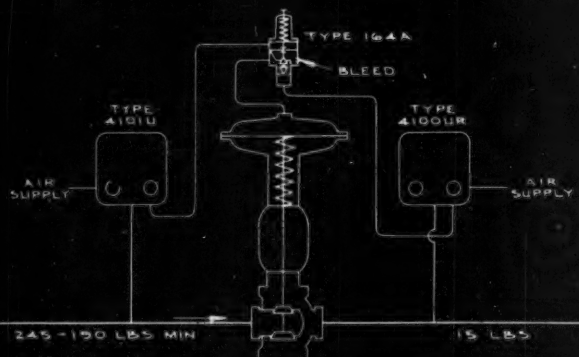
SUCH AS

TWO-WAY ACTION for SAFETY LOCK-UP



Lock-up system using Type 164A to close air circuit to diaphragm of main valve in case of plant air failure. Main valve will be held in position at time of supply pressure failure.

or THREE-WAY ACTION for SWITCH AIR CIRCUITS

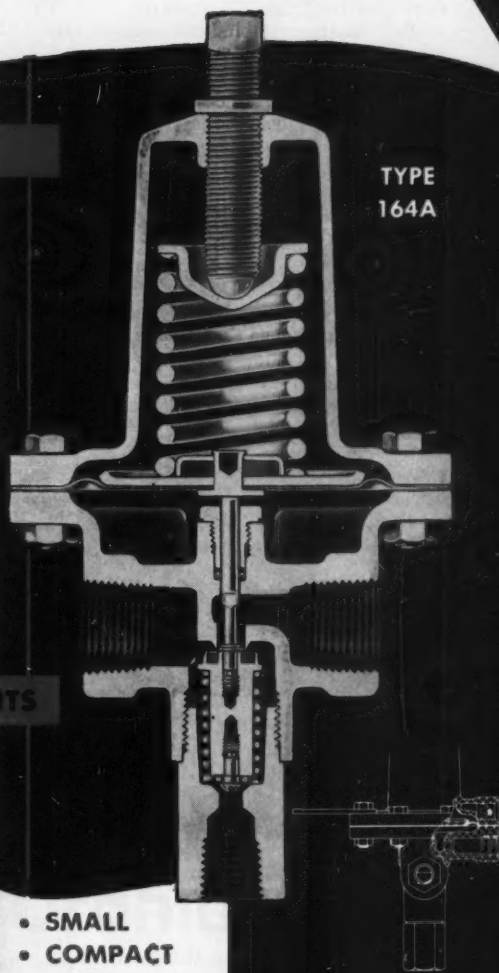


Pressure reduction normally handled by 4100UR Wizard. If inlet pressure to main valve falls below a predetermined amount Type 4101U snap-acting Wizard bleeds pressure off Type 164A switching valve causing 3-way valve to change position so as to close control line pressure and bleed main valve diaphragm pressure to atmosphere. Main valve will stay closed until inlet pressure is restored to desired amount.

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WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL



- SMALL
- COMPACT
- SELF CONTAINED

Side view of Type 164 showing 1/4" Control Line Connection. Control Chamber is separate from body chamber.

SIZES 1/4" or 1/2"

CONTROL SPRING
RANGES PSI

3 to 15
5 to 20
5 to 35
30 to 60

PRESSURE CHANGE
ON DIAPHRAGM FOR
FULL VALVE STROKE, PSI

2
2 1/2
4
5 1/4

MATERIALS

Zinc die cast body and spring case,
composition diaphragm and valve disc.

• Members of a profession

In the first category are such practical items as fair compensation, practical recognition as part of management and appropriate methods to bring grievances to top management's attention. The second includes time and facilities for research, study, reading, publishing and otherwise maintaining professional status—and a job whose emphasis is not on day-to-day output but on ideas contributed to the long-run worth of the business.

How to Set Salaries

In determining professional compensation, top management might well consider these rules:

- Have an objective current salary evaluation so that job content is fully considered.
- Pay a salary based on reasonable area-industry considerations.
- Keep salary and prerequisites of professionals well above those of the rank and file workers.

These points are all self-ex-

When a fellow learns that men with a good deal more experience make only a few dollars a month more than new men, one of the real incentives to growth is removed.

John E. Taft, Vice President
Engineers & Scientists of America

planatory. But to the third let me add that not only compensation but also status is involved.

Being Part of Management

Professional employees like to feel that they are part of management—as indeed they are. But many top managements, by failing to consult them on programs and policy, encourage them to think otherwise.

Some of the most successful personnel programs dealing with professional people include monthly meetings with top management at which production or research requirements are fully

discussed and the ideas of all brought out. Other plants prefer regular informal gatherings at which the professionals are taken into top management's confidence on production or development plans and urged to give frank opinions.

The results not only have raised the professional's morale, but have generally taught top management something about the technical requirements of their company's production processes.

Handling Grievances

Professional workers, like any others, have grievances. Adequate machinery needs to be developed to bring these to light and to remove them promptly, simply because so much of the company's future depends on these workers.

The type of grievance machinery can vary. In small plants the "open door" may suffice; in larger companies more formalized channels would seem called for. The National Industrial Conference Board has published an interesting study* of how such channels work.

How One Firm Beat Routine

If it is true that workers in general want recognition as human beings, as well as economic return for their labor, it's doubly true that professionals require such recognition.

For example, one large concern found that despite high compensation and fine working condition, morale of its engineers was at a very low ebb. In digging into the situation it found that for some years these men had teamed on highly important defense work. But while this was interesting during the first two years, it became routine thereafter.

* Studies in Personnel Policies, No. 109, 1950.

To men who have achieved professional status through superior abilities and long study, routine work is horribly depressing. Realizing this, the company at its own expense authorized each engineer to spend part of his

Many grievances may arise relative to wages and working conditions, and since an individual is unable to accomplish the desired results (on his own), it is mandatory that he help form and belong to an organization which will carry on collective bargaining with his employer.

Russell M. Stephens, President
American Federation
of Technical Engineers, AFL-CIO

time during the next six months in developing ideas he had gained from his defense work experience. The company then held a conference at a prominent winter resort where each man read a paper on his project then discussed it with other members of the staff.

Results were three-fold:

- Immense improvement in morale and enthusiasm.
- Sharp decline in engineer turnover.
- Scientific and engineering knowledge which vastly aided the company's expansion program and which could not have been gotten otherwise.

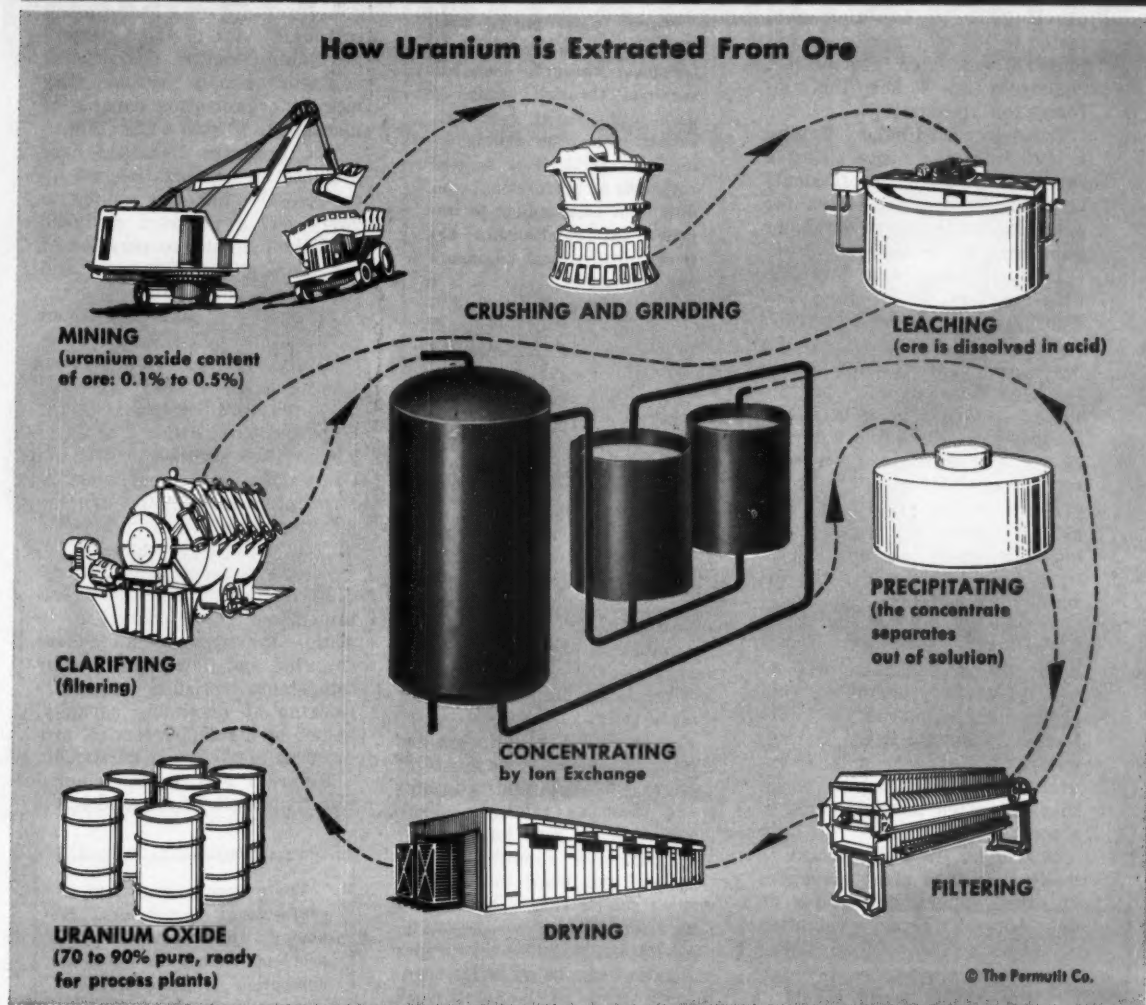
Giving Practical Perquisites

The rapid advance of knowledge makes it tough for the professional to keep up with his field. The more conscientious must spend evenings reading the latest books and journals; others let them slide and their work (and the company's) suffers.

Next Month: Profile of the Project Engineer

Project engineers handle the rugged job of organizing, planning, directing and controlling the engineering and building of process plants. Their work takes generous measures of both engineering and management skills. How they've developed these skills, how they use them and how much they're paid for using them formed the basis for a recent study. You'll get all of the results in May's You and Your Job.

PROCESSES: Ion exchange "swaps" chemicals in solution at high speed ... purifies, recovers, concentrates, separates. An example:



Ion Exchange Cuts Uranium Costs

One reason uranium is costly is because it's spread so thin. Even a ton of good ore contains only 10 lb. of uranium oxide. And when that ton of ore is dissolved, its 10 lb. of uranium is hidden in 5 tons of leach solution!

• Solutions that dilute would be almost too expensive to handle if it weren't for the ability of ion exchange to pick out "the needle in the haystack." Take the above example ... ion exchange-precipitation takes the 10 lb. of uranium out of the 10,000 lb. of leach solution in one simple step ... then delivers it in as little as 12 lb. of concentrate! It also discards other elements that generally stick close to uranium

... eliminating special up-grading steps. The results: *more* uranium per ton of ore and at a lower cost than by former methods ... and *higher grade* uranium that cuts subsequent refining costs.

• That's why Permutit ion exchange is at work at African, Canadian and U. S. uranium mines.

• This compact process also concentrates metals from industrial wastes. For example, it recovers valuable chromium from exhausted plating baths and rinse waters and, at the same time, eliminates a tough and costly waste disposal problem. It recovers copper and zinc from rayon wastes. It also removes unwanted minerals and other impuri-

ties from process and boiler feed water, chemicals, sugar solutions and hundreds of other products.

• We'll be glad to look into ways it might apply to your process. Write to The Permutit Company, Dept. CE-4, 330 W. 42nd St., New York 36, N. Y.

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ION EXCHANGE for Water Conditioning

Chemical Processing • Industrial Waste Treatment

Many firms find that it pays to provide library facilities, subscribe to the required books and journals and give professional employees time to keep their information up-to-date.

Some go even further. Taking a leaf from the universities, a few companies grant professional employees sabbatical leaves for graduate study, or research, or publishing their work.

Professionals have considerable interest in attending conventions of their societies. Although such meetings may be longer on job offers than on professional knowledge, a good personnel program is a mainstay against such offers and will permit liberal provisions for convention attendance.

Likewise, liberality pays off in patent policies. If a new technique is really valuable, it is equally valuable to keep the inventor well satisfied.

Evaluating the Professional

Finally, management will do well to avoid attempts to rate professional employees on a day-to-day production basis. Contribution of ideas cannot be measured on an output chart; yet they are often most valuable to a company's future.

Above all, it is important to make sure that plant managers or other supervisory people do not apply ordinary valuation

Progression levels should be developed so that men of equal ability and performance advance equally with respect to position, pay, honor, responsibility and recognition. The specialist who knows all there is to know about process "X" should be on the same hierarchical level in all respects as the administrator who heads an important department.

James H. Taylor, Director of Industrial Relations
The Procter & Gamble Co.

standards to professional personnel. Failure to observe this rule invites engineers to seek greener pastures.

Much has been done through discussions and conferences; through economic surveys; through study of such problems as communication, utilization and training and through a mutual emphasis on professional conditions of employment to improve the relationship between professional engineers and industry.

Milton F. Lunch, Executive Assistant
National Society of Professional Engineers

Using Engineers Better

No personnel program, however good, can create engineers if engineers do not exist. It will, however, go a long way toward assuring a company of maximum availability of the potential. Nevertheless, combined with this program is the need for more effective use of engineering talent than is typical.

For example, if engineers are needed as designers, we must get used to the idea that we can't spare them as salesmen. This means that we may have to pay our engineers enough so that they will not want to be salesmen. I realize this is heresy but it is also reality.

A lot of progress in proper utilization can be made by turning over some of the detail work of engineers to technicians. Use of careful job descriptions in setting up a good salary program can also serve to delineate those functions of the engineer's job which can be done by properly supervised, less skilled personnel.

There's considerable room in most companies for stretching engineering talent in this manner. If companies would give as much thought to using existing personnel as they've given to fancy recruiting, I believe a real dent could be made in the engineering shortage.

It's Up to Management

I'd like to emphasize that no personnel program, whether it be for engineers or for rank and file, can hope to achieve its objectives if the management or-

ganization is not clearly established and defined. Today many companies lack a sound personnel administration program of engineers simply because they lack an organization capable of inaugurating such a program.

The program discussed here assumes an organization set up to give the line the ability to carry out a program designed with the help and cooperation of the personnel department and other staff specialists.

It also goes almost without saying that such a program requires the complete backing of top management, and by that I mean the No. 1 boy and no undercutting down the line, if the program is to succeed. Moreover, the complete backing of top management means that top management must be willing to spend a little now for the future—an investment in people and ideas, so that production can be maintained and cost controlled in years to come with ideas sprouted and developed now by competent, satisfied engineers working at maximum capacity, helped by a sound personnel program.

Before I end, let me emphasize that what I have said is the

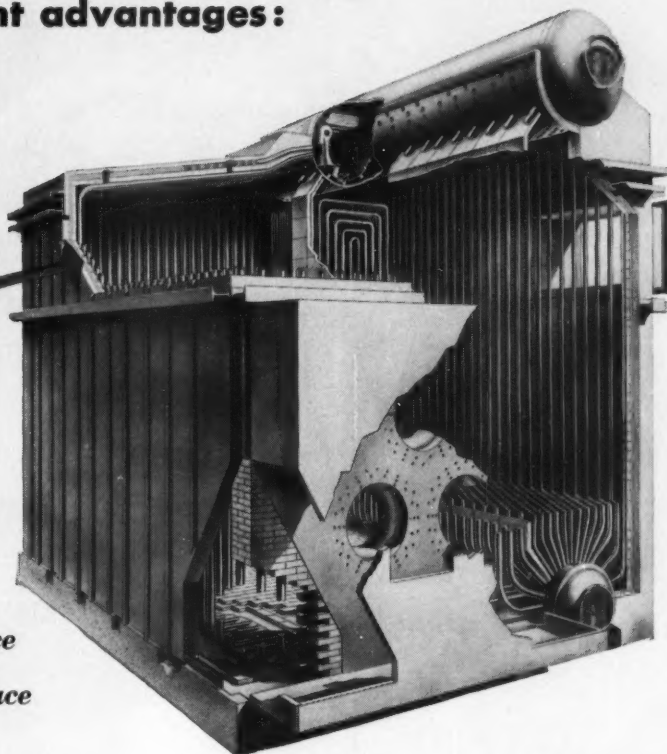
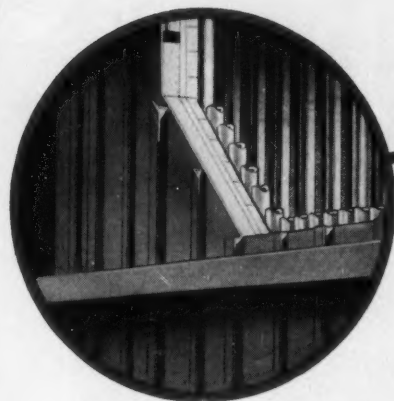
The proper management of professional employees is among the most difficult problems facing the business enterprise. It cannot be sidestepped by asserting that he is part of management. Nor would it be solved by considering him just a species of skilled worker and a "fellow-proletarian." Managing the professional requires recognition that he is distinct.

Peter F. Drucker,
Industrial Consultant

result of my general study and experience and does not relate to the Penn-Texas Corp. To be sure, we have engineering personnel problems like everybody else. But, since I have only been with Penn-Texas a few months, I am as yet in no position to evaluate with sufficient thoroughness our own problems and programs.

Another Feature of the FW Series "SC" Standard Boiler... COMPLETELY WATER-COOLED WALLS

offer two important advantages:



1. *Minimum setting maintenance*
2. *Prevention of excessive furnace exit-gas temperatures*

All furnace walls of this Series "SC" Steam Generator are water-cooled by closely-spaced 3" OD tubes. As a result, setting maintenance is minimized and excessive furnace exit-gas temperatures prevented. The tubes are backed by first-quality refractory, heavy-duty insulation and fully-stayed steel casing.

This is another advanced-design feature of the Foster Wheeler Series "SC" Steam Generator that has been developed primarily for reducing power and process steam costs in industrial plants.

Series "SC" employs a standardized design. Dimensions and structural details are fixed. Yet the design provides a wide

choice of working temperatures and pressures, balanced draft or pressurized firing, type and location of heat recovery equipment, type and location of fans and drives, oil or gas firing. This means that the "SC" boiler and its auxiliary equipment can be properly integrated to meet your individual plant needs.

FW Series "SC" Steam Generators are available for oil or gas firing, in capacities from 50,000 to 150,000 lb./hr., for pressures to 1500 psi and superheated steam temperatures to 950 F.

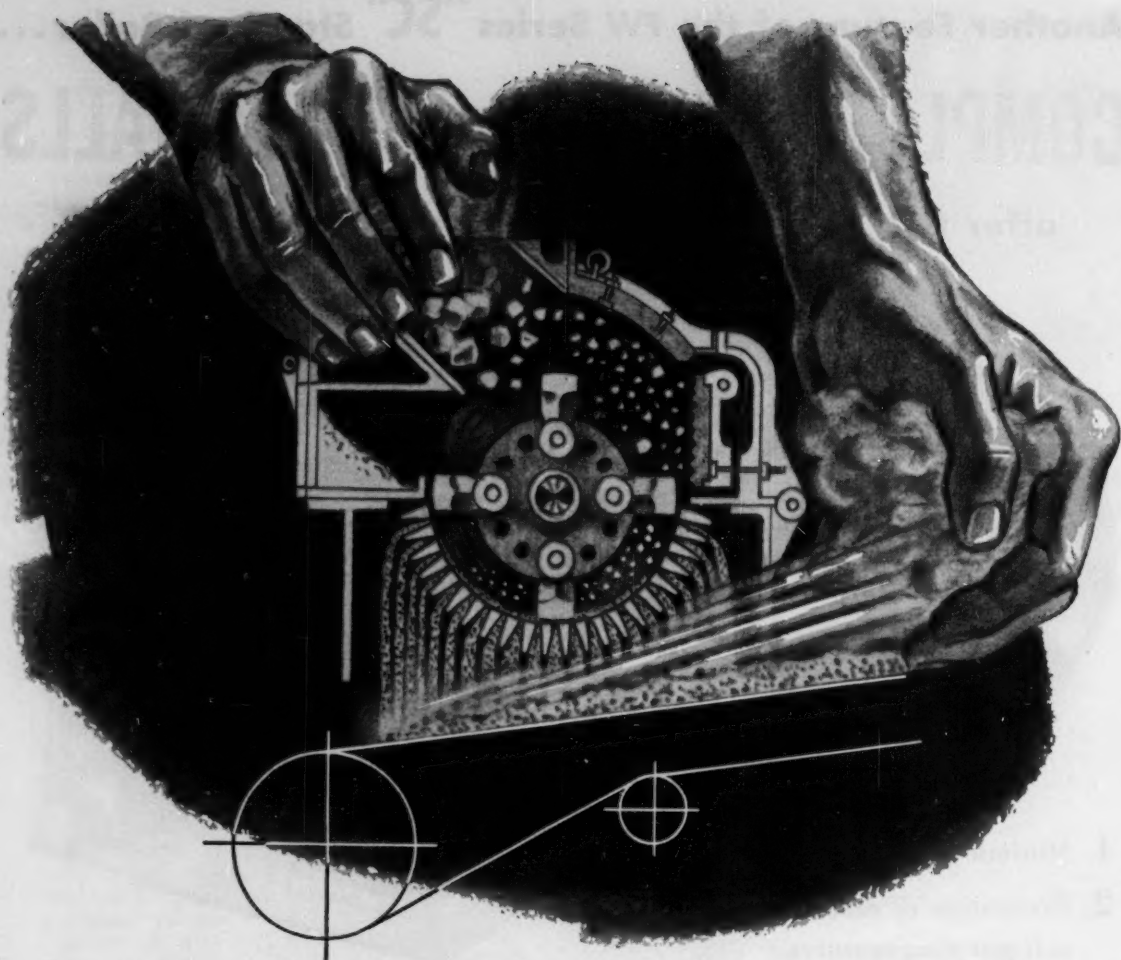
For further information, write *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

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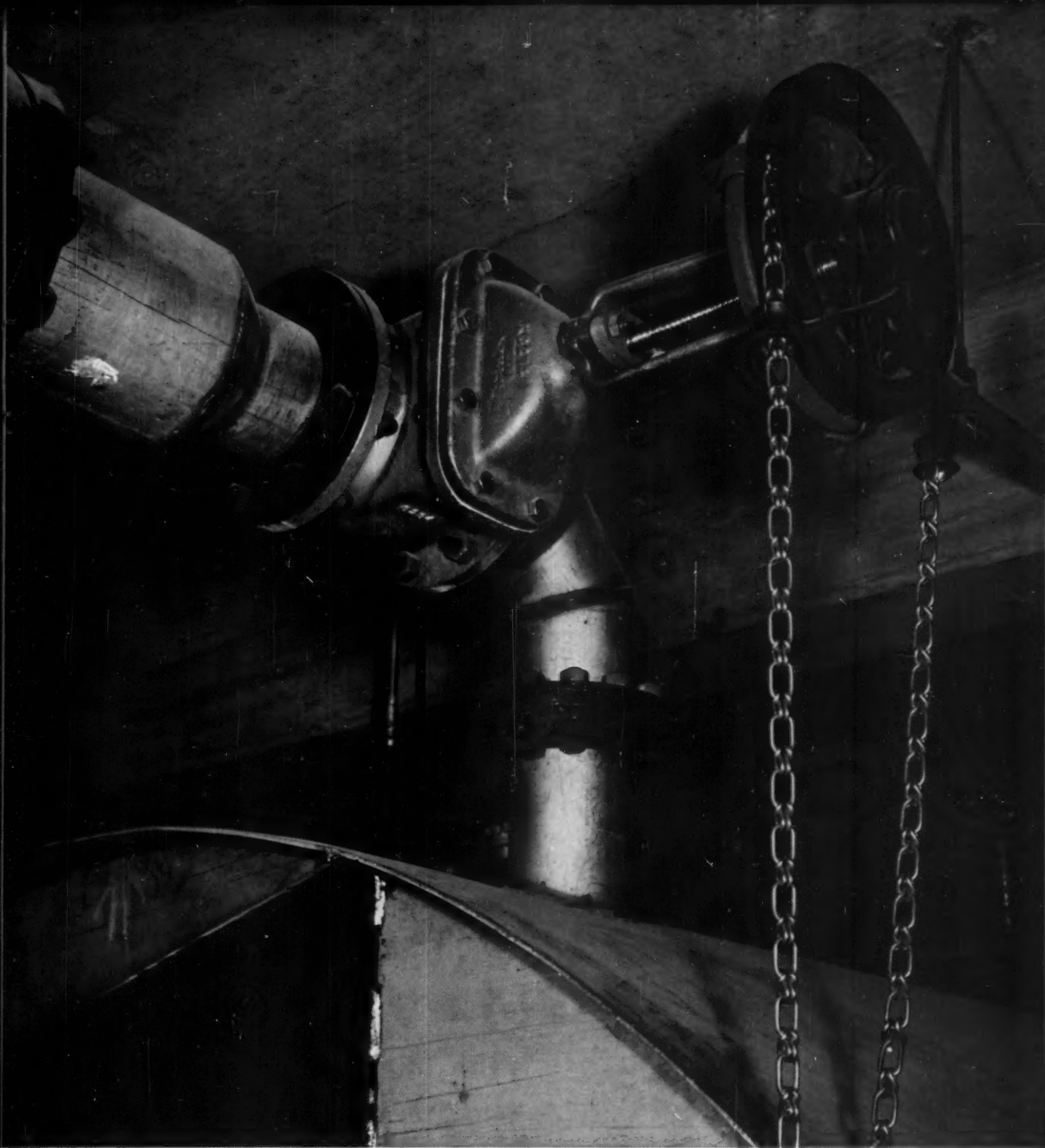
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Film censor at work

At 950-acre Kodak Park, the film-producing plant of Eastman Kodak Co. in Rochester, N. Y., they take no chances on film contamination.

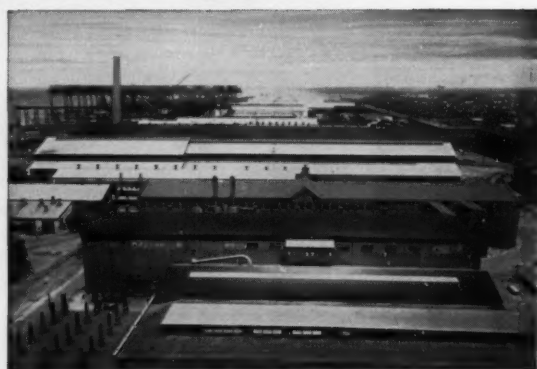
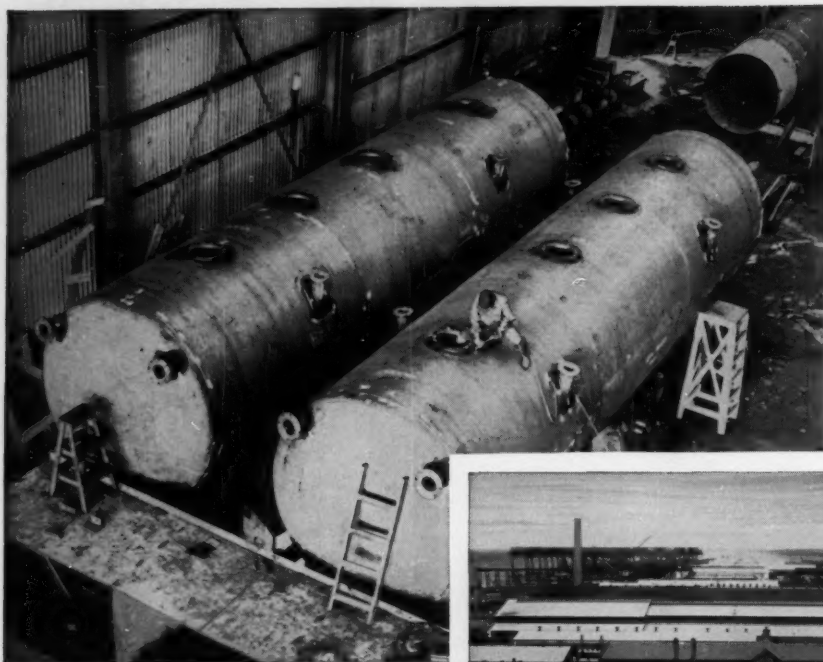
For example, in the operation shown here, a red-wheeled Aloyco stainless steel valve rules out of the picture dangerous rust and iron contaminants which would spoil the thick fluid which is called "dope." These valves control the flow of dope onto

roll-coating wheels, where solvents are driven off with heat. The dry film base is then readied for the final coat of emulsion.

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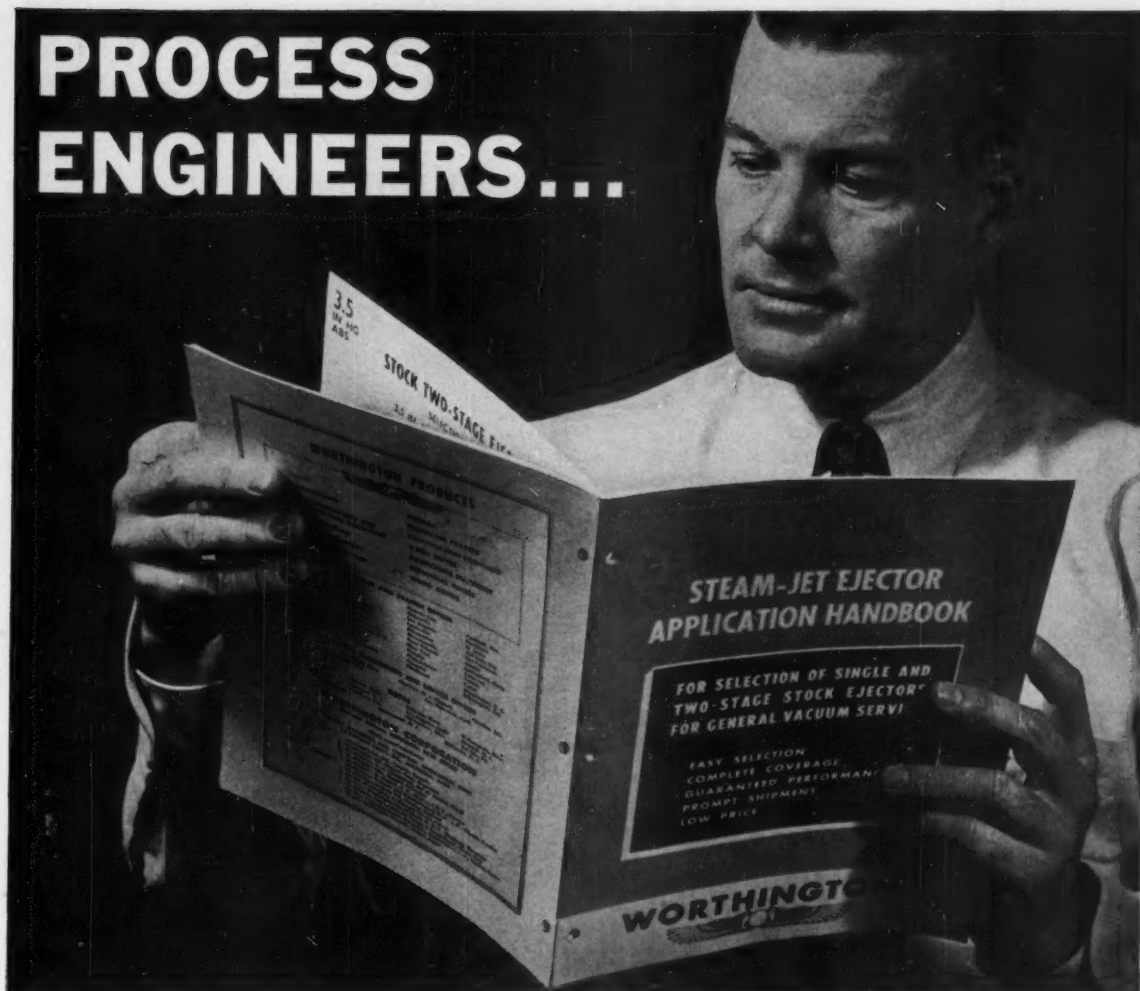
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Best Designs for Lead Installations

Recommended practice for the fabrication of lead towers and flues, floors, pipe, fittings, etc. by a company that is both a user and producer.

This month we present Part II of Best Designs for Lead Installations. The article contains in-

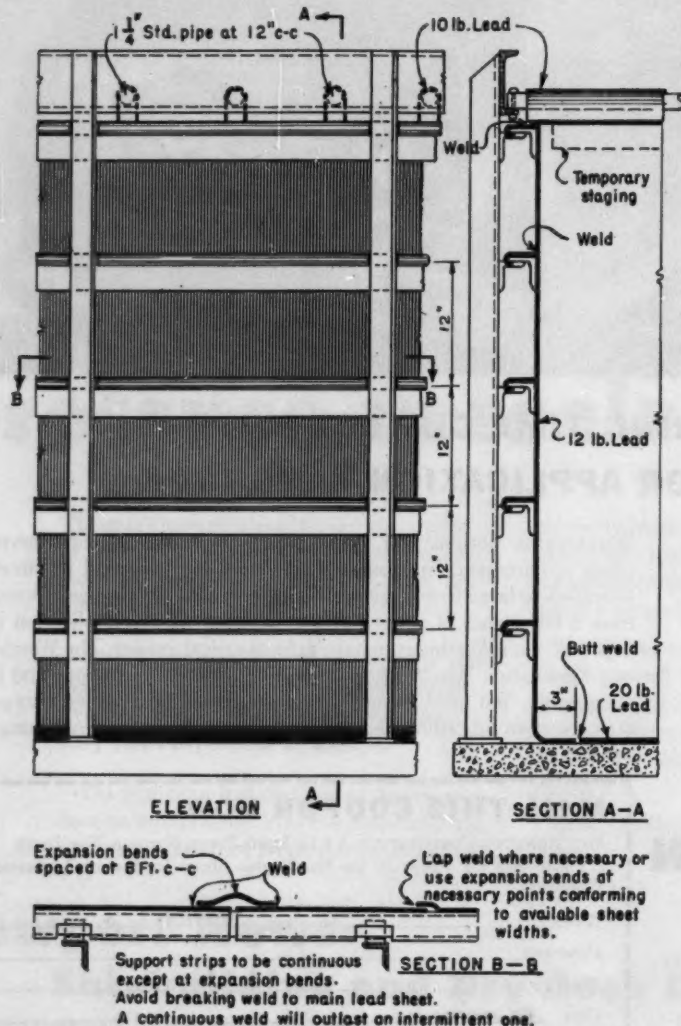
formation from a special company report "Application of Lead and Lead Alloys in the Chemical

and Metallurgical Industries" just prepared by the Engineering Division of The Consolidated Mining and Smelting Co. of Canada, Ltd., Trail, B. C.—primarily for the edification of their maintenance personnel.

It is of particular interest to design, maintenance and operating engineers in the chemical industry. Cominco's extensive experience as a user of lead in corrosive environments is embodied in the present series of articles.

The section which immediately follows is a continuation of other material about towers and flues appearing in last month's Corrosion Forum.

Lead flue with structural steel supports



Towers and Flues

Lead lined timber construction has been recently superseded by steel basket type construction for some applications in which lead sheets are formed and supported. This type of fabrication is favored for vessels and is preferred because they may be thoroughly inspected while in service. Faults are readily apparent and repairs are relatively simple, sometimes being done without removing the equipment from service.

The accompanying drawings indicate the more important details in this type of construction. One shows the recommended fabrication details using structural steel support sections while the other shows the details using pipe section supports for the framework.

Flues of Circular Section

At one time it was considered necessary to support lead pipes along their full length by using wood or steel cradles or troughs. Modern techniques have all but eliminated this method of support by using lead stiffeners which support the conduit along its length.

With the outmoded type of support, it was difficult to locate a leak in a pipe or flue. Once

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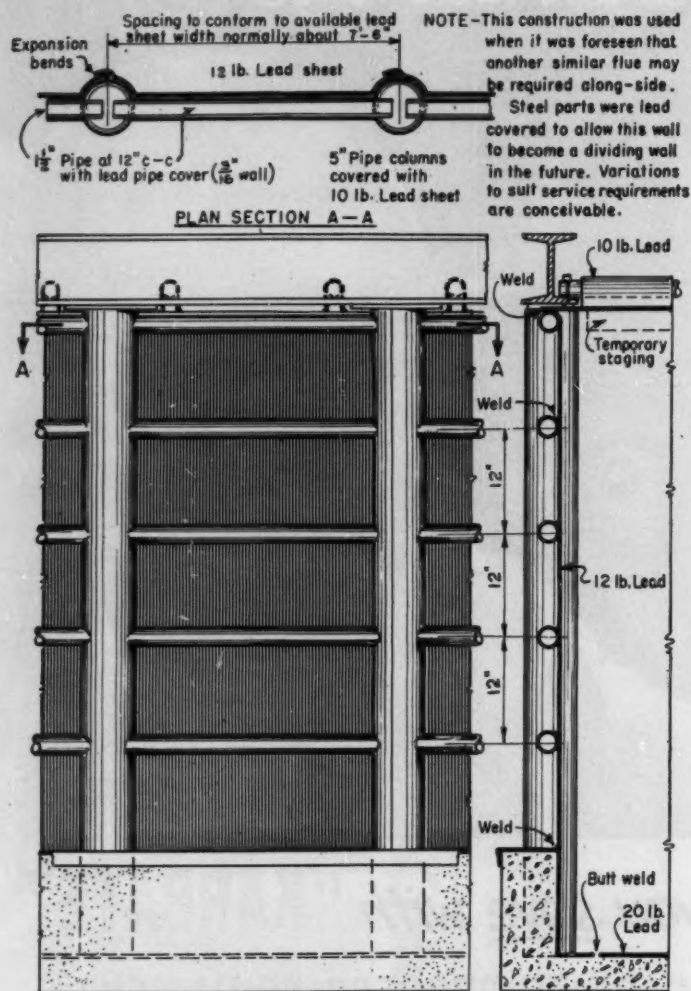
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Lead flue with pipe section supports



located, access to the fault for repair was generally quite difficult and expensive. Using the more modern methods of support, faults are usually quite apparent by casual observation and are accessible for repair. Painting is eliminated and over-all maintenance costs are comparatively low.

In designing flues of this type, it is recommended that conservative maximum allowable stresses at the maximum operating temperature be used in the design. (Refer to p. 228, Chem. Eng., March 1955).

Typical construction details of flues in this category are shown.

In straight runs between fixed points, it is recommended that expansion joints be installed in the flues.

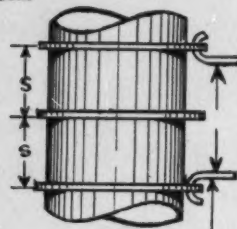
Sewer Manholes

Lead is an excellent lining for sewer manholes, especially in the vicinity of industrial plants where the nature of the waste solution may be injurious to other linings. Typical details are shown, with recommended procedure for construction of the manholes.

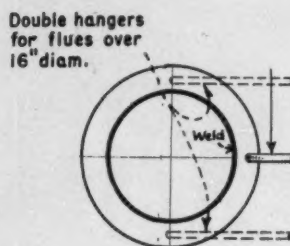
Green concrete has always been considered to be injurious to lead. Where the two would otherwise be in contact, use of

Circular flues

HANGERS

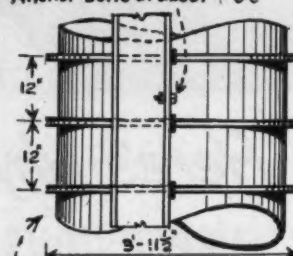


Double hangers for flues over 16" diam.

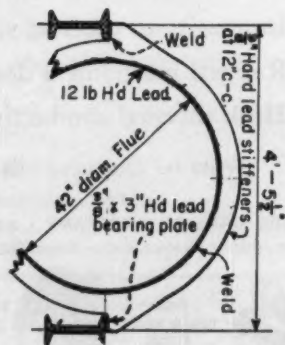


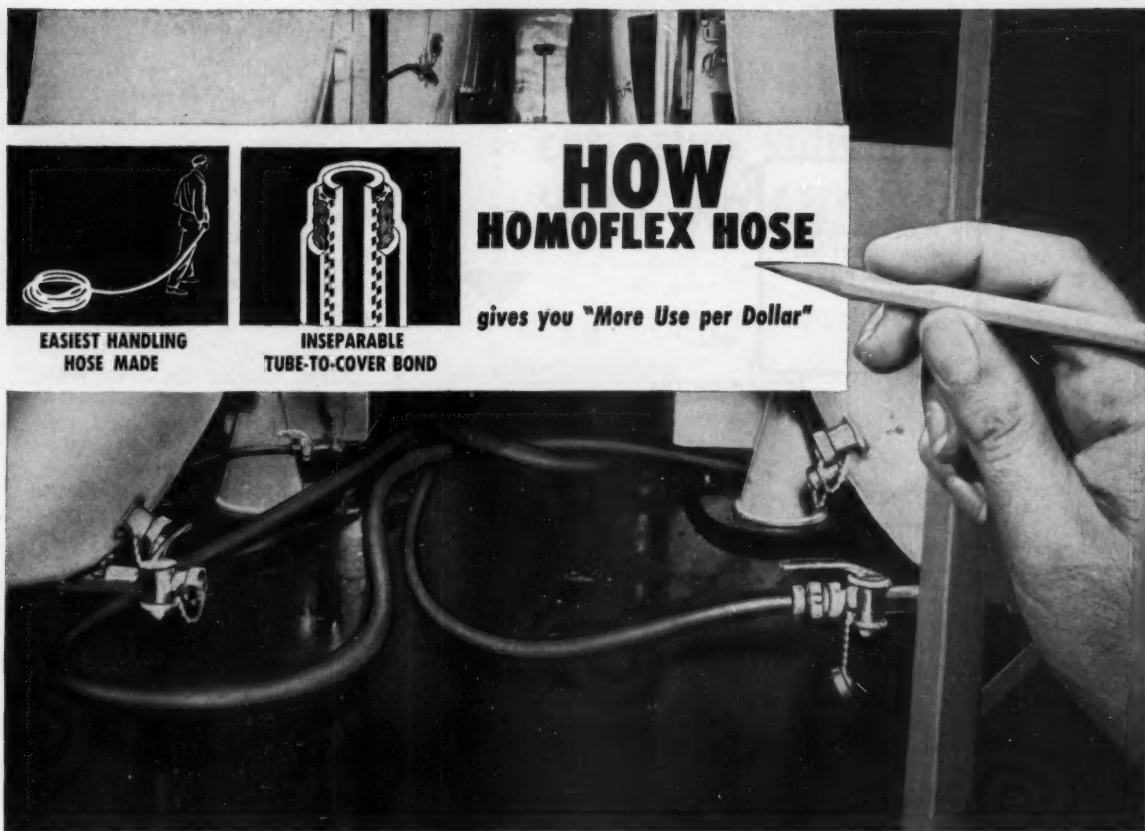
STIFFENERS

Anchor bolts at about 4' c-c



Sections of flue made in 7'-6" lengths and butt welded together in field.





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Flat Belts



V-Belts



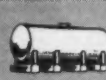
Conveyor Belt



Hose



Roll Covering



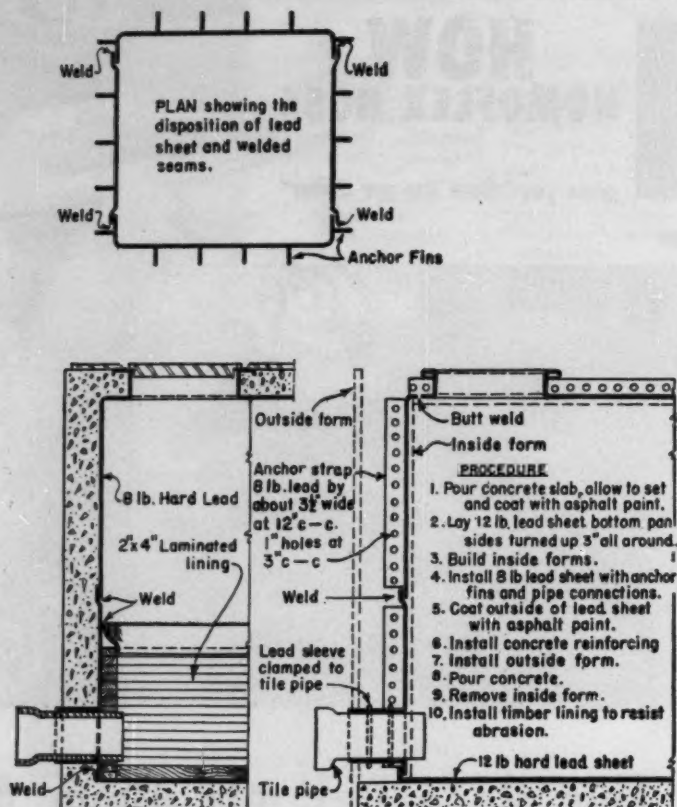
Tank Lining



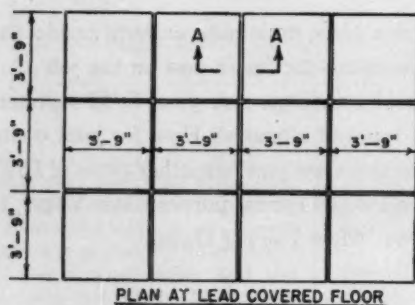
Abrasive Wheels

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings • Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Laundry Pads and Covers • Bowling Balls

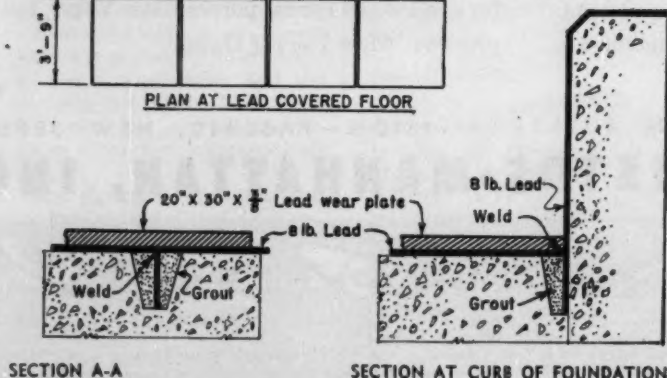
Sewer manholes



Lead-covered concrete floors



When grouting of machine is necessary, top lead is installed after machine has been set to elevation and grouted.



asphalt paint is recommended procedure.

Lead Covered Floors

In sulfuric acid plants and other places where there is a danger of "soil sulfation," it is becoming standard practice to lead-cover the floors to stop acid from being absorbed into the soil.

"Soil sulfation" with its resultant heaving can cause serious misalignment of equipment. It is next to impossible to prescribe a cure without expensive procedures.

Where lead is used over a large expanse of floor, it is often difficult to trace back from the result of the leak to the leak in lead itself. Modern practice in this regard specifies that the floor be sectionalized so that a leak in the lead covering will cause only a local result and the disturbing fault is confined to a small area. Typical details are illustrated in the drawing.

Trend in Lead Pipe Fabrication

In the past, a great deal of unnecessary expense was often incurred in making streamlined fabricated fittings, since skilled labor was required and the product was not economical for the attained result.

When pipe bends are required of sufficiently large radius, straight pipe may be filled and packed with sand and bent. During this operation, the outer wall of the pipe is stretched and accordingly becomes thinner, placing a limitation on the minimum recommended bend radius. For pipe diameters normally bent in this manner, the table below shows the recommended minimum bend radii.

When short-radius bends and fittings are required they may be purchased as stock items in one of four ways:

1. With plain ends for welding.
2. With solid lead flanges welded in place.

Inside Diameter of Pipe, in.	Minimum Recommended Bend Radius, in.
1	4
2	8
3	12
4	16
5	20
6	24

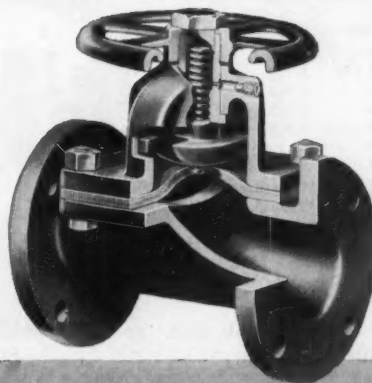
9,121

ways to valve corrosive substances with HILLS-McCANNA valves

36 BONNET ASSEMBLIES	14 DIAPHRAGMS	27 BODIES
<p>HANDWHEEL OPERATED—13 types including models with indicators, auxiliary handles, enameled bonnet and outside stem and yoke.</p> <p>QUICK OPENING—2 lever operated models go from full open to full closed in a 180° turn.</p> <p>SLIDING STEM—5 models to permit adaptation to a wide variety of operators.</p> <p>EXTENDED STEM—2 models provide easier operation in difficult locations.</p> <p>CHAINWHEEL OPERATED—1 model.</p> <p>AIR OPERATED—9 models offered with a choice of air cylinder or diaphragm motor operators.</p> <p>UNBALANCED HYDRAULIC OR PNEUMATIC—1 model utilizing pressure on valve diaphragm to close, line pressure to open.</p> <p>MOTOR OPERATED—3 models providing a choice of electric motor operators.</p>	<p>RUBBER—3 types including high acid/alkaline resistant, abrasion resistant and temperature resistant.</p> <p>NEOPRENE—5 types including acid, alkaline, oil and heat resistant formulations, freeze resistant and white, noncontaminating formulations.</p> <p>HYCAR—acid, oil and heat resistant.</p> <p>TYGON—acid resistant.</p> <p>COMPAR—solvent resistant.</p> <p>KEL-F—acid resistant.</p> <p>POLYETHYLENE—acid resistant.</p> <p>TEFLON—maximum chemical resistance.</p>	<p>CAST IRON—ASTM Class 3 minimum.</p> <p>CAST STEEL—standard foundry finish.</p> <p>CAST IRON, LINED—choice of 8 linings including hard or soft rubber, neoprene, glass, lead, Saran and Lithcote.</p> <p>CAST IRON, COATED—Stalpic coated.</p> <p>ALLOY—choice of 10 alloys including several types of stainless steel, Durimet, Everdur, Monel and Hastelloy.</p> <p>ALUMINUM—Cast.</p> <p>NICKEL—97%+ pure.</p> <p>PLASTIC—Choice of 4 materials: polyvinyl chloride, Uscolite, Saran or polyethylene.</p>

In this unmatched selection of operators, diaphragms and body materials is the answer to virtually every corrosion resistant valving problem. In addition, nearly 25 years of application of the Saunders Patent valve by Hills-McCanna has developed extensive experience records on the best way to handle thousands of corrosive substances. The combination of a complete choice of materials plus Hills-McCanna "know how" is your assurance of getting the best valve for your service.

Hills-McCanna diaphragm valves are offered in sizes from 3/4" through 14". Dependent on size and type of body and diaphragm materials, they will handle pressures to 150 psi, temperatures to 350° F. For specific recommendations send an outline of your corrosion resistant valving problem. To have full data at hand, ask for the Hills-McCanna valve catalog.



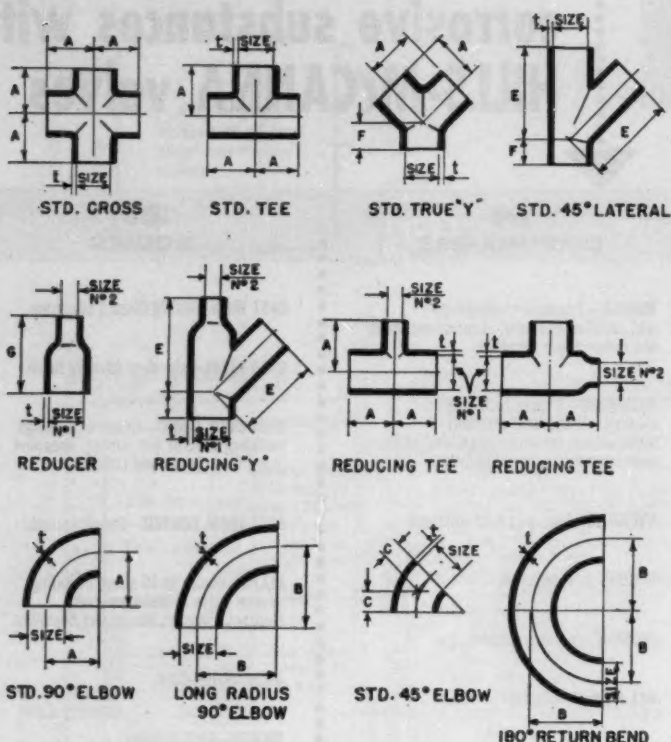
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Lead pipe fittings



Fitting Sizes and Dimensions, Inches

Size	A	B	C	E	F	G	t
2	4 1/2	6 1/2	2 1/2	8	2 1/2		As required
2 1/2	5	7	3	9 1/2	2 1/2	5 1/2	
3	5 1/2	7	3	10	3	6	
4	6 1/2	9	4	12	3	7	Normally 1/4" and 3/8"
5	7 1/2	10 1/4	4 1/2	13 1/2	3 1/2	8	
6	8	11 1/2	5	14 1/2	3 1/2	9	
8	9	14	5 1/2	17 1/2	4 1/2	11	
10	11	16 1/2	6 1/2	20 1/2	5	12	
12	12	19	7 1/2	24 1/2	5 1/2	14	

3. With cast iron or steel slip-on flanges.

4. Over-size for flanging or Van Stoning in the field.

The fittings shown in the drawing above are normally available in chemical lead and 6% antimonial lead.

Flanges

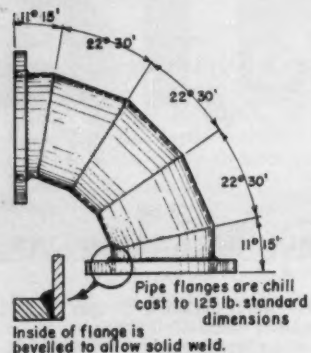
When flanges are used, the diameter and drilling normally conforms to American Standards Association requirements for

Class 125 cast iron flanges. Standard dimensions are shown in the table.

Some typical piping details are shown under the following subdivisions:

90°, 5-piece elbow. Depending on the degree of streamlining necessary, these elbows can be made of 3, 5 or 7 pieces. Up to 6 in. inside diameter size, straight pipe may be cut and re-welded to form the elbow. Larger sizes are normally developed on

Five-piece elbow



DETAIL OF 5 PIECE 90° ELBOW.

Note:—Up to 6" diam. straight pipe may be mitre cut. For pipe fittings greater than 6" diam. part may be developed on sheet lead, cut, rolled and assembled.

Where a large number of like fittings are needed, cast fittings may be more economical.

Special pipe weld



Cut away this section of lead pipe with hand saw on near side. Weld far side of joint from inside of pipe. Replace cut away section and complete weld from outside.

NEXT MONTH

LEAD DESIGNS—III

See next month's Corrosion Forum for Part III of Best Designs for Lead Installations. Here you will find recommended practice for the design of high-velocity coolers and other lead constructions as it applies to chemical plant operations.

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SPECIAL BULLETIN 8210A

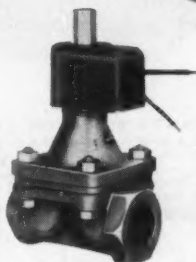
It's a complex matter to control the flow of highly corrosive gases and liquids automatically—even more difficult in areas where an accidental spark could cause instant chaos. Yet the new ASCO Two Way Solenoid Valve with explosion-proof enclosure—designed to meet NEMA VII and UL requirements—provides for just such safe, automatic control.

This all stainless steel Special Bulletin 8210A Solenoid Valve is self contained and requires no separate auxiliary pressure—and can be mounted in any position. Simple design—only two operating parts—the diaphragm and the all stainless steel solenoid core—assures foolproof operation.

The unique design and construction of the full line of ASCO Corrosion Resistant Valves facilitate the use of many special body materials. This is why ASCO Valves adapt to handle almost any corrosive gas or liquid. And ASCO Valves provide absolutely tight seating for pressures up to 1000 psi—function perfectly at temperatures to 450°F.—and are available in 1/8" to 3" pipe sizes. Standard, watertight, or explosion-proof enclosures may be specified.

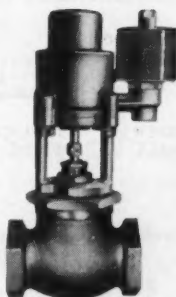
There's *one* source that solves virtually any solenoid valve problem—ASCO. Have the ASCO engineer call—or write for data: "Solenoid Valves for Corrosive Applications."

Here are other typical ASCO Valves for two and three way corrosive applications.



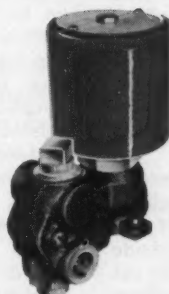
SPECIAL BULLETIN 8336

Especially suited for tight shut-off control of highly corrosive fluids containing suspended solids. Various body materials and diaphragms may be specified.



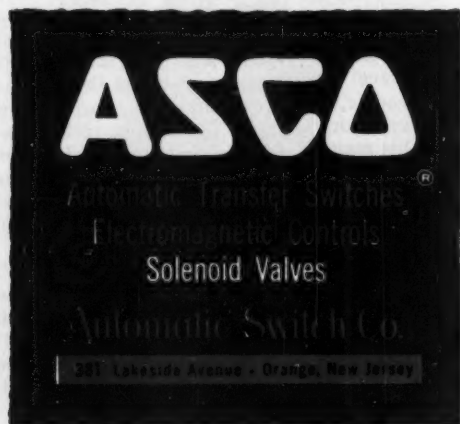
BULLETIN 8338

Cylinder operated, solenoid pilot controlled, closes on loss of auxiliary pressure. Construction makes it possible to use body materials that suit the corrosive fluid.



BULLETIN 8300

A three way valve for directing flow from a common inlet into one of two outlets. Available in all iron, steel, or stainless steel construction.

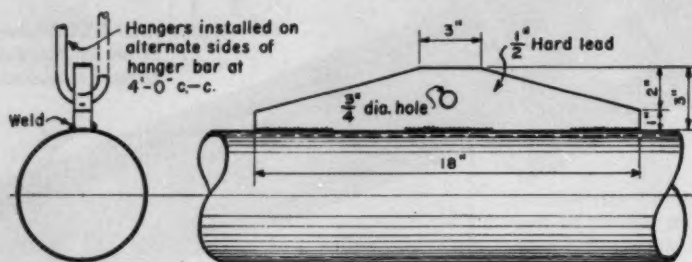


Butt-welded pipe

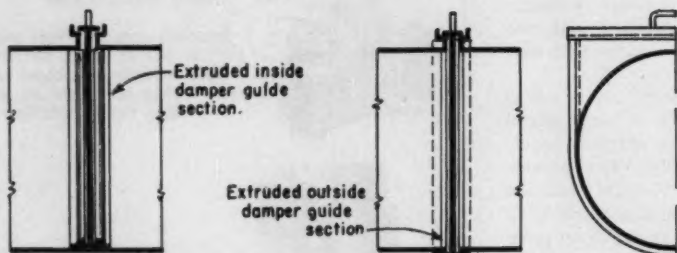
Butt welding of lead pipe is preferable to lap or cup welds. With hydrogen-oxygen flame butt welds may be made in vertical or horizontal pipe runs without rolling the pipe to maintain a down weld position.

Standards Used for Lead Flanges

Nominal Pipe Size, In.	O.D. of Flange, In.	Thickness of Flange, In.	Number of Holes	Diam. of Holes, In.	Diam. of B. C., In.
2	6	3/4	4	3/4	4 3/4
2 1/2	7	3/4	4	3/4	5 1/2
3	7 1/2	1	4	3/4	6
4	9	1	8	3/4	7 1/2
5	10	1	8	7/8	8 1/2
6	11	1	8	7/8	9 1/2
8	13 1/2	1 1/4	8	7/8	11 3/4
10	16	1 1/4	12	1	14 1/4
12	19	1 1/4	12	1	17

Recommended method of hanging lead pipe

are used in square or rectangular ducts or launders, and are limited in their use. Outside damper guides are used in flues and ducts of various shapes and sizes.

Damper guides

APPLICATION OF INSIDE DAMPER GUIDE TO RECTANGULAR DUCT OR LAUNDER

APPLICATION OF OUTSIDE DAMPER GUIDE TO CIRCULAR DUCT.

sheet lead, cut, rolled and welded to form the elbow.

Typical butt welded pipe. Experience has shown that lead pipe can be butt-welded in either a vertical or horizontal pipe run and that results are superior to those when a "cup" or "lap" joint is used. This is true for position-welded field joints as well as for "rolled joints."

Special pipe weld. When a pipe run is close to a wall or other structure, making it impossible to weld from the outside in position, a section may be cut from the pipe at the joint, allow-

ing part of the weld to be made from the inside. The cut away part is then rewelded in place.

Hanging lead pipe. Lead pipe up to 6 in. in diameter (normally) can be hung in this manner. Lengths of pipe up to 30 ft. long have been prefabricated complete with hanger bars, hoisted into position and joints field-welded into position with butt welds.

Inside and Outside Damper Guides

Use of extruded inside and outside damper guide sections is illustrated. Inside damper guides

Phosphating Guide

A guide for personnel engaged in the application of protective phosphate coatings on ferrous metals, prepared by Rock Island Arsenal Laboratory, has been released to industry.

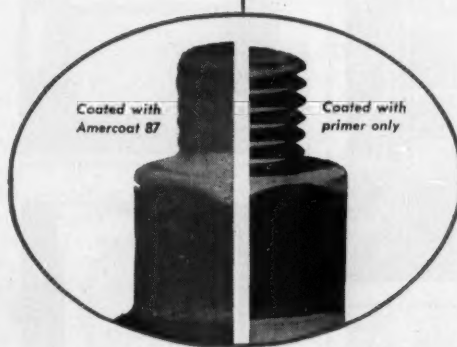
The report describes the mechanical equipment and its installation, cleaning operations, processing solutions and procedures, and the chemical control methods required for the application of these protective black finishes to ordnance materials.

A study of methods indicated that the degreaser plus four-tank phosphating unit is entirely satisfactory and represents the most simple, complete system possible. Other cleaning methods than trichlorethylene vapor degreasing may be used but require additional equipment, and may introduce troublesome effects on the subsequent formation of phosphate coatings. The volume includes a list of the chemicals and materials required for proper maintenance and operation of a phosphating system, and details of a phosphating unit are illustrated.

This report, PB 111726 "Phosphating Materials and Process," Rock Island Arsenal Laboratory, May 1954, is available from OTS, U. S. Department of Commerce, Washington 25, price \$2.25. It contains 88 pages.

you can

CUT YOUR MAINTENANCE PAINTING COSTS UP TO 50% *with* AMERCOAT 87 VINYL MASTIC



HERE IS HOW THIS REMARKABLE PROTECTIVE COATING CAN SAVE YOU MONEY:

1. Only one cross spray coat over a primed surface is required for complete protection—this means lower labor costs.
2. Fewer scaffolding and rigging shifts are required.
3. Less down time—dries to touch in minutes, eliminates the risk of contamination between coats.
4. Greater thickness means longer life—lower cost per square foot per year.

Amercoat 87's thixotropic characteristic helps provide extra thickness on sharp edges and irregular surfaces; it is non-porous and will not crack or check.

Amercoat 87 combines the time-tested chemical and weather resistance of vinyl coatings with the thickness of conventional mastics, yet is easily applied with standard industrial spray equipment.

We will be pleased to send you our technical bulletin describing this coating in detail.

Amercoat
CORPORATION

DEPT. AD, 4809 FIRESTONE BOULEVARD, SOUTH GATE, CALIFORNIA Evanston, Ill. • Kenilworth, N.J. • Jacksonville, Fla. • Houston, Tex.

BRISTOL'S INSTRUMENTATION

BRISTOL ELECTRONIC DYNAMASTERS will measure and automatically control any variable — from temperature to viscosity

ANY VARIABLE that can be translated into an electrical quantity — temperature, pressure, pH, voltage, speed, smoke density, resistance, and hundreds of others — can be measured, recorded, and automatically controlled by Bristol's Electronic Dynamaster® Potentiometer and Bridge instruments.

Whatever your measurement or automatic control problem may be, whether it be in the plant, laboratory, or pilot plant, there is a Bristol Electronic Dynamaster for it.

ADVANTAGES of the Bristol Electronic Dynamaster:

1. Continuous standardization with no dry cells, eliminates need for dry cells and standardizing mechanism—Results: no interruption to control, no batteries to replace.
2. High accuracy . . . fast operation . . . continuous electronic measurement.
3. Simple in design . . . few moving parts.
4. Easy to use and service . . . little or no maintenance required.
5. Flexible in application.

6. Rugged in construction . . . especially built for industrial plants, pilot plants, and for research and laboratory use . . . unaffected by vibration.

7. Plant operating men quickly become familiar with this instrument and like to use it.

MODEL FOR EVERY REQUIREMENT. Dynamaster Potentiometers and Bridge Instruments are available as single-pen, two-pen, and multiple-record (up to 24 points) strip-chart instruments and as round-chart instruments.

ELECTRIC AND PNEUMATIC CONTROLLERS. Both strip-and round-chart instruments are made in a very wide variety of controllers that meet every control requirement, including the following in a great many forms:

Electric Control — on-off, proportional input, 3-position, proportioning, proportional with automatic reset, and time-program.

Pneumatic Control — on-off, proportional, proportional with reset, and proportional with reset and derivative.

**Sun Oil Plant uses
Dynamaster Recorders**



Dynamaster Multiple-Point Temperature Recorders are used in the Control Room of the huge new 15-million-dollar Petrochemical Plant of Sun Oil Company at Marcus Hook, Pa. The plant produces chemical grade benzene, toluene, and xylenes.

Some of the instruments shown measure the temperatures of feed stock into and out of heaters, at dozens of points. Others record temperatures in cylindrical reactors, where the petroleum molecules are rearranged (reformed) in the presence of the platinum catalyst.

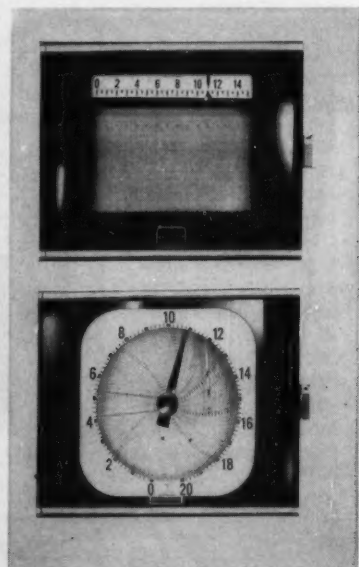


LIQUID LATEX TEMPERATURE is controlled precisely to remove ammonia from natural latex prior to foaming in this plant.

Automatic plant uses Bristol's Dynamaster Instruments

Automation is a reality here at the Buffalo Foam Rubber Products plant of the Dunlop Tire and Rubber Corporation. This automatic plant, designed and built by Mechanical Handling Systems, Inc., Detroit, uses Bristol Dyna-

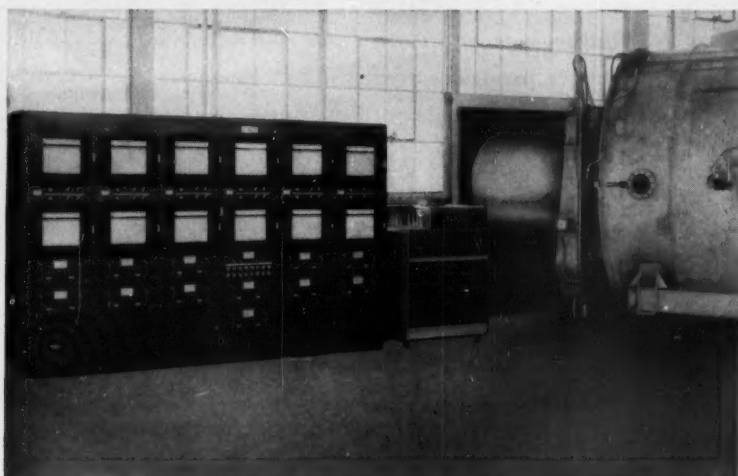
master Electronic Instruments and Automatic Controllers as part of a process employing today's most advanced automatic production techniques. The result — greater efficiency and productivity, lower costs, improved product.



BRISTOL'S DYNAMASTER INSTRUMENTS are available with strip or round chart. Same instrument except for chart drive.

NEWS

... news and information about automatic controlling,
recording and telemetering instruments from Bristol
... leaders in human-engineered instrumentation



BRISTOL'S DYNAMASTER INSTRUMENTS record test data from wind tunnel (right) and feed information to card punching machines at United Aircraft's Research Dept.

Bristol's Dynamaster Recorders feed analogue-to-digital converters

At United Aircraft Research Dept., Bristol's Dynamaster Recorders not only supply high-speed chart records of wind tunnel tests but feed analogue-to-digital converters that punch test data on cards, at 100 cards per minute, for analysis by electronic computers.

Dynamasters in this installation record the output of strain gauge pick-ups placed on test models in the wind tunnel.

The models are subject to air at supersonic-velocities.

High-speed Dynamaster Recorders (1-second full-scale pen travel) inform test operators of test conditions between card punchings. Since the test only lasts from 10 to 20 seconds, it is vital that every bit of information be gathered for analysis.

Dynamasters aid gas dispatching in Midwest

Bristol Dynamaster Metameter Telemeters, at a large midwestern gas utility, help gas dispatchers route gas throughout their distribution system.

These strip-chart Dynamaster Metameter Telemeters record gas pressure at strategic points in the system. This information used to be called in periodically by field men—a slower and less accurate process.

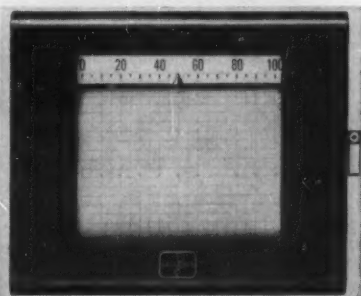
Using the continuous, accurate, up-to-the-minute information supplied by the wide-strip telemeter receivers, the gas dispatcher effects much better pressure regulation in the gas supply than

with the old system—particularly during periods of unexpected demand.



New high-speed electronic Dynamaster Recorder

0.4-second for full scale pen travel



NEW 0.4-SECOND Dynamaster recorder

Freedom from overshoot on long or short traverses is a key feature of Bristol's new high-speed Dynamaster Recorder.

This high-speed instrument sets new standards for chart recorders in the fields of rocket and jet-engine testing, wind tunnel measurements, automatic-machine-tool control, scientific laboratory testing and numerous industrial applications.

SPECIFICATIONS:

Speed: 0.4 second to within 0.25% of balance for full-scale step-response without overshoot.

Sensitivity: Dead band less than 0.1% of full scale.

Ranges: Minimum range of 1 millivolt d-c.

Chart: 12¼ in., 11 in. calibrated.

Chart Speeds: Up to 4 in. per second.

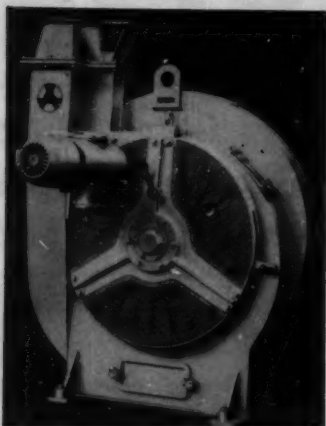
No matter what your measurement problem is, a Bristol Dynamaster Potentiometer or Bridge instrument will solve it for you.

Write for all the facts

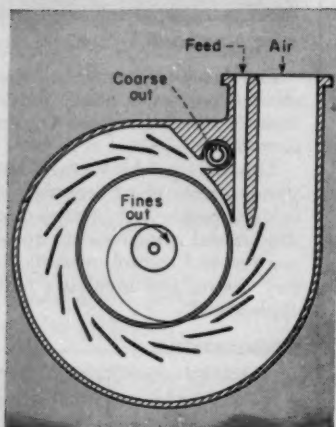
To get the whole story on these rugged, precision instruments, write today for your free copy of the 36-page bulletin P1245. The Bristol Company, 113 Bristol Road, Waterbury 20, Conn.

5.24

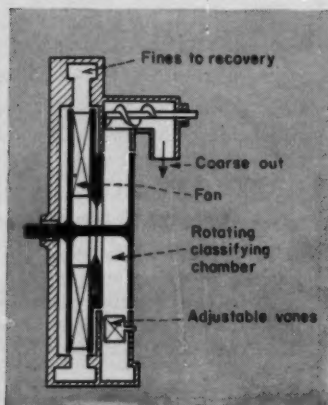
.. WHAT'S NEWS AT BRISTOL... WHAT'S NEWS AT BRISTOL... WHAT'S



How It Looks



How It Feeds



How It Works

Spiral Sizes Powder Cleanly

Attains high efficiency on particles below 325 mesh. Device produces uniform flow patterns that segregate different sizes into accurately defined zones.

Powders with mixed particle sizes now are split into desired size ranges that are cleaner and more sharply defined than was possible previously. So report several U.S. and numerous European processors now using the Alpine Mikroplex spiral classifier.

Machine features a rotating separation chamber that eliminates drag turbulence to achieve high uniformity in the air flow pattern. Within this close-to-ideal environment, powder is separated into two sharply divided fractions.

Material can be cut cleanly at any size from 44 micron (325 mesh) down to 2.5 micron, a performance hitherto unattainable with air classifiers. Cut size is easily adjusted even while machine is operating.

Efficiency better than 70% is claimed for cuts coarser than 5 microns. Most air classifiers are less than 60% efficient at 50 microns.

In contrast with other air classifiers, cut size varies only very slightly with the quantity being processed. Likewise, the proportion of fines in the feed has no influence on the operation.

Materials now being handled commercially with this equipment range from the hardest abrasives to wheat flour.

► Balance Between Forces—The Mikroplex machine is said to classify particles under precise equilibrium conditions. At the demarcation or separation point (cut size) between the two fractions two opposing forces are in equilibrium for one particle size only.

These are the forces produced by the spiral pattern of air flowing through the unit. A vor-

tex action drags fine particles inward; centrifugal force acting on larger particles overcomes frictional drag forcing them outward.

For a given flow velocity and spiral angle, one particle size will be at equilibrium. Opposing forces balance so that particles at this size travel in a circle rather than a spiral. By permitting particles inside this circle to continue inward while particles outside the circle are diverted to a discharge outlet, a sharp separation is obtained.

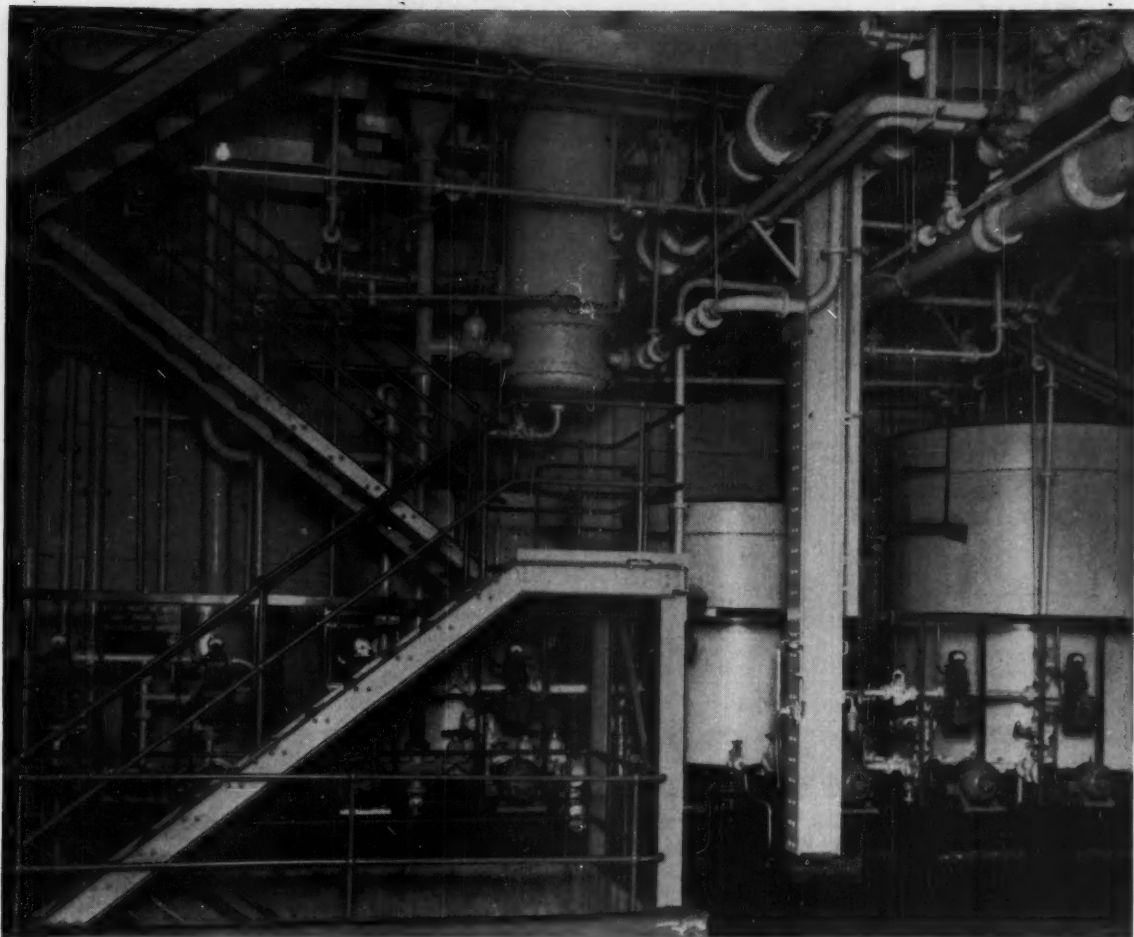
► Uniform Flow—Success of this operation depends entirely upon particles of a given size constantly following the same flow pattern under a given set of conditions.

Mikroplex classifier achieves uniform flow with a flat, cylindrical separating chamber having rotating walls. Flow follows identical paths in the axially adjacent layers because of the flat proportions. And because the chamber walls rotate along with the air mass, drag is eliminated in the boundary layers.

These factors alone account for sharply increased output and clearly defined separation. And they permit close agreement between actual separation and the theoretical cut size.

► Trial Run—Powder falls into the classifying chamber through duct. Air, entering through a separate inlet, streams through the guide vanes and carries the powder with it. Fine material continues inward in accordance with a predetermined separating equilibrium. Coarse material separates from the fines and is detached by knife edge and conveyed by worm to outlet.

Fine material and air leave the classifying chamber through



Dependable the World Over!

Thousands of continuous hours without breakdown, without stoppage is not unusual with a LaBour pump.

With this unequalled record, it's no wonder that men, the world over, who specify equipment for corrosive liquids usually select LaBour pumps to handle their particular jobs.

LaBour pumps went to North Ireland to work for the W. J. Fraser Ltd. in its spin bath recovery plant. Distance made no difference to the designing engi-

neers of this plant for they knew they could depend on LaBour pumps for continuous service without interruption . . . and so can you.

For more than 30 years, in plant after plant having the toughest chemical jobs, LaBour pumps have been handling the operations smoothly and efficiently.

Take a tip from men in the know—specify the pump that gives them day-in, day-out service, LaBour . . . it's **DEPENDABLE THE WORLD OVER!**

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LaBOUR

THE LABOUR COMPANY, INC., Elkhart, Indiana, U.S.A.



Newsworthy Equipment This Month

Equipment Cost Indexes, p. 238

New Processing Equipment

Powder Classifier	236A
Vibrating Screen	238A
Salt Dissolvers	238B
Recovery System	238C
Particle Accelerator	240A
Pilot Dryer	240B
Small Reactors	240C
Spray Dryer	240D
Horizontal Dryer	240E
Pulverizer	240F
Filter Pump	240G

New Packaging & Handling Equipment

Freight Car	242A
Bulk Trailer	242B
Steel Drums	242C
Straddle Carrier	242D

New Electrical & Mechanical Equipment

D.C. Motor	244A
Gearmotor	246A

Reduction Pulley	246B
Speed Reducer	246C
Sealed Motor	246D
X-Ray TV	246E

New Fluids Handling Equipment

Proportioning Pump	248A
Double-Ended Pump	248B
All-Purpose Pump	248C
Leakproof Pump	248D
Flange Unions	248E

New Materials of Construction

Hard Surfacing	250A
Pipe Covering	250B
Lining Material	250C
Formed-in-Place Tubes	250D
Resurfacing Material	250E

New Instruments & Controls

pH Instrument	252A
Gas Alarm	252B
Air Regulator	252C
Potentiometers	252D
Fail-Safe Monitor	252E

↑ Page number is also Reader Service code number ↓

For more details, use Reader Service Card

central opening leading into fan. Discharge from fan enters suitable collecting system.

► **Present Models** — Mikroplex classifier is available in three models: 132 MP rated at 3 hp. for 110-440 lb. per hr.; 400 MP rated 30 hp. for 1,100-5,500 lb. per hr.; and 800 MP with 40 hp. for 2,600-13,000 lb. per hr.

Maintenance cost is reported very low. All wearing parts are replaceable without welding or machining. On abrasive service, wear points are protected by rubber covering.

A complete set of service parts is included with each machine. Service personnel is available. — **Lukens Laboratories**, 227 California St., Newton 58, Mass. 236A

Vibrating Screen

For wet or dry materials, runs at higher speed.

Speed of the HS Vibrex screen is 30 to 80% greater than previous models. At the higher speed, this new screen requires less headroom than previous models since only 10 to 15 deg. of inclination is needed com-

pared with 25 to 45 deg. for most types of fine screens.

Screen operates at 3,300 rpm. when set for a $\frac{3}{8}$ -in. stroke and 2,400 when operating on a $\frac{1}{2}$ in. stroke. Unit is designed especially for use with screen cloth of 10 to 80 openings per lineal inch. Under certain conditions it will handle separations up to 100 mesh.—**Hewitt-Robins, Inc.**, Stamford, Conn. 238A

Equipment Cost Indexes

Industry	Sept. 1955	Dec. 1955
Avg. of all.....	191.0	196.9

Process Industries

Cement mfg.	182.8	188.8
Chemical	191.8	198.1
Clay products	177.6	183.4
Glass mfg.	181.2	187.1
Paint mfg.	184.6	190.6
Paper mfg.	184.9	190.9
Petroleum ind.	188.3	194.5
Rubber ind.	190.8	197.0
Process ind. avg....	188.9	194.6

Related Industries

Elec. power equip....	193.6	199.9
Mining, milling	193.0	199.3
Refrigerating	211.8	219.0
Steam power	180.7	186.6

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1956, pp. 194-5 for annual averages since 1913.

Salt Dissolvers

Fabricated of plastic offer advantages.

Dissolvers for rock and evaporated salt as well as brine storage tanks are being made for the first time of polyester glass-reinforced plastics.

These new tanks completely eliminate corrosion problems. They need no paint. Because they are translucent, the true level of salt is visible from any position around the units.—**International Salt Co., Inc.**, Scranton, Pa. 238B

Recovery System

New line of standard adsorbers for recovering solvent.

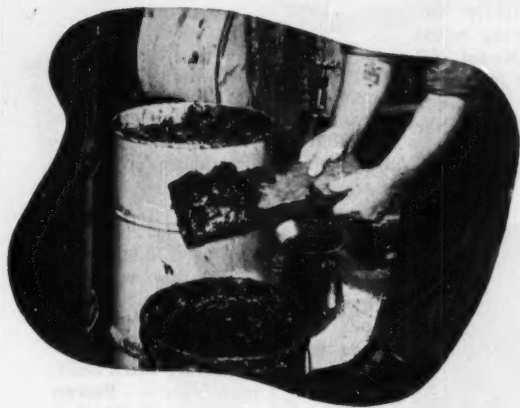
Resorb adsorbers are now available in a new line of standard completely self-contained units. Utilizing activated carbon, units are employed for recovering solvents, purifying gases and conditioning air.

Self-contained units require no field assembly work. They are merely installed according to written instructions and

EASY WAY TO PUT OUTPUT ON THE UPSWING!

shift lubrication methods from

Backward to Forward!



ALEMITE AIR-OPERATED TRANSFER PUMP

gives 63% faster lubricant transfer

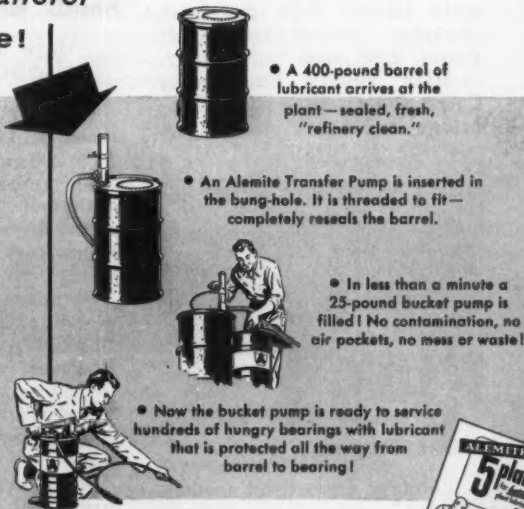
...saves right down the line!

The real cost of plant lubrication is not just the lubricant alone! Actually, it's the time and labor needed to get the lubricant out of the original drum—into a bucket pump or powergun—and then applying it to machine bearings. That's where the real costs add up!

And that's why an Alemite Air-Operated Transfer Pump can cut costs in your plant—especially if you are using old-fashioned hand methods of lubrication. It transfers 37 pounds of pressure gun grease per minute—direct from the original drum—completely sealing the lubricant at all times—protecting against mess, waste and contamination.

It's fast—and versatile! It can even handle alcohol, cutting oils, kerosene—almost any non-corrosive non-abrasive fluid you use by the drum. Delivers light fluids at a rate of up to 15 gallons per minute!

There's no better way to speed up your handling of lubricants—because an Alemite Transfer Pump pays for itself by saving man-hours and machine-hours as well!



FREE! New Booklet:

"5 Plans for Better Lubrication"
Alemite, Dept. CC-46, 1850 Diversey Pkwy.
Chicago 14, Illinois

Please send me my FREE copy of "5 Plans for Better Lubrication."

ALEMITE

Ask anyone in industry



Name.....
Company.....
Address.....
City..... Zone..... State.....

NEW PROCESSING EQUIPMENT . . .

hooked to steam, water and electrical supply lines.

Basic units are Series 50 and 70 for solvent concentrations between 0.2 and 1.0% by volume; Series 60 for relatively low air volume with high concentration of solvent; and Series 30 for relatively high air flows carrying low solvent concentration in the 0.02 to 0.2% range. — Barnebey-Cheney Co., Columbus 19, Ohio. 238C

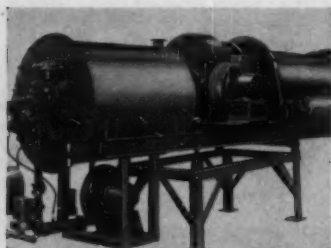
Particle Accelerator

Most powerful radiation source now available.

Radiation in the form of electrons, x-rays, positive ions or neutrons all can be produced by the new 3-million-volt Van de Graaff particle accelerator. It is reported to be the most powerful and versatile machine radiation source now available commercially.

Machine can sterilize drugs, preserve foods, crosslink plastics and initiate chemical reactions such as polymerization, halogenation and oxidation.

Power output rating of the generator at 3-million volts is 3,000 w. of radiation. Radiation field is several hundred times more intense than the most powerful radioactive cobalt source now used industrially. — High Voltage Engineering Corp., 7 University Rd., Cambridge 38, Mass. 240A



Pilot Dryer

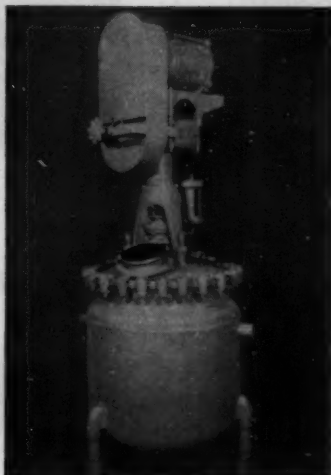
Rotary type, three models.

Ruggles-Coles rotary dryers now are available in a selection of three models for pilot plant use. All units are extremely compact, require only fuel and electrical connections before they start operating. They can

be moved easily from place to place.

Model XH-XF is a single shell, direct heat, gas fired unit for either parallel or counter-flow operation. Model XB is a double shell, indirect, gas-fired dryer suited particularly for high temperature drying without contamination. Model XC is a steam tube dryer for small capacity operations.

All models are built in either mild or stainless steel.—Hardinge Co., Inc., York, Pa. 240B



Small Reactors

Have new features to extend utility.

Construction features added recently to Pfaudler's small (5 to 100 gal.) glass reactors include pressure lubricator for seals and new hydraulic or air motor drives. Also, vessels can be converted to high pressure rating with standardized parts.

Standard low pressure reactors in series P are rated for 25 or 30 psi. internal pressure. However, rating can be boosted to 150 psi. by using a thicker cover with heavier nozzles and clamps, and by reinforcing the body.

At higher pressure the pressure seal lubricator permits holding seal chamber fluid at desired conditions while keeping cost low.

Basic hydraulic drive gives speed range from 100 to 1,500 rpm. It's explosion proof, eliminates belts, belt guards, motor

supports and gear reducers in most applications. — Pfaudler Co., Rochester, N. Y. 240C

Spray Dryer

Available for pilot operation.

New conical laboratory spray dryer offers greater drying capacity than manufacturer's popular table model. With a choice of either nozzle or centrifugal atomization dryer is rugged, disassembles rapidly and cleans easily.

Drying air rate is 250 cfm. Heat loads up to 230,000 Btu. per hr. are possible with an evaporation rate of up to 80 lb. per hr. Patented air inlets in the drying chamber side wall permit shock-cooling ultra heat-sensitive materials. — Bowen Engineering, Inc., 13 Station Rd., North Branch, N. J. 240D

Horizontal Dryer

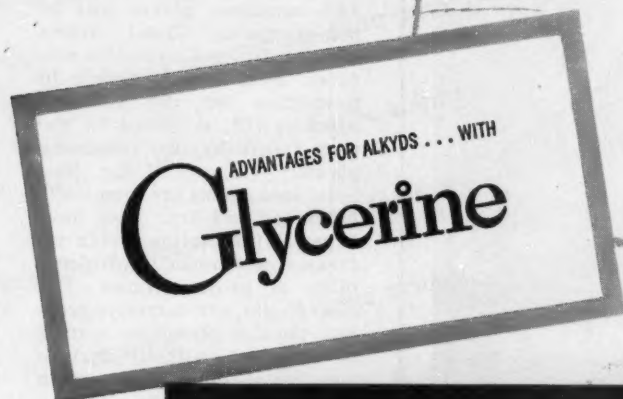
Pilot size, spray type with nozzle atomizer.

Horizontal, pilot size spray dryer has been installed by Buflovak for developing techniques in spray drying chemicals, drugs and foods.

Unit features extreme flexibility for drying products that can be atomized through a nozzle. It requires no more head room than is normally available in industrial plants. And it can be cleaned easily to cut maintenance costs and time. — Buflovak Equipment Div., Blaw-Knox Co., 1579 Fillmore Ave., Buffalo 11, N. Y. 240E

Pulverizer for grinds in 4 to 20 mesh range controls particles size precisely, has higher throughput because downtime for cleaning is less. Protection of product purity is basic feature.—Metals Disintegrating Co., Inc., 130 Chatham Rd., Summit, N. J. 240F

Filter pump LSIN-20 is self-priming unit for filtering corrosives at 200-300 gph. rate. Density of filter tubes variable to trap 1-150 micron particles.—Sethco Mfg. Co., 70 Willoughby St., Brooklyn 1, N. Y. 240G



NEW WEATHER RESISTANCE

A new type of weather-resistant alkyd resin—made from isophthalic acid and *Glycerine*—is now being offered in experimental quantities.

The stability and compatibility of *Glycerine* as a polyol in surface-coating alkyds and its low MW/Hydroxyl ratio, have for years made a wide range of resin properties feasible.

Now *Glycerine* is combined with isophthalic, a dibasic acid which only recently became available in commercial quantities and which imparts higher viscosity with lower acid number. It also permits higher fatty acid content at workable consistencies. The result: excellent outdoor durability, mildew-resistance and gloss-retention—all demonstrated in a five-year exposure test completed recently. Among 100 alkyd-based enamels tested, an isophthalic-soybean-*Glycerine* alkyd enamel stood up best.

Here again, nothing takes the place of *Glycerine*.

This balanced group of properties keeps **Glycerine's** usefulness growing

HYGROSCOPICITY • STABILITY •
SOLVENT POWER • VISCOSITY • NONVOLATILITY •
NONTOXICITY • TASTE • MW/HYDROXYL RATIO •

HUMECTANT •
CARRIER • SOLVENT • LUBRICANT • SOFTENER •
EMOLLIENT • ANTI-FREEZE • ALKYD BASE •



CHECK AND SEND FOR TECHNICAL DATA



20-page booklet
"Glycerine Alkyds
Tailored to Need"



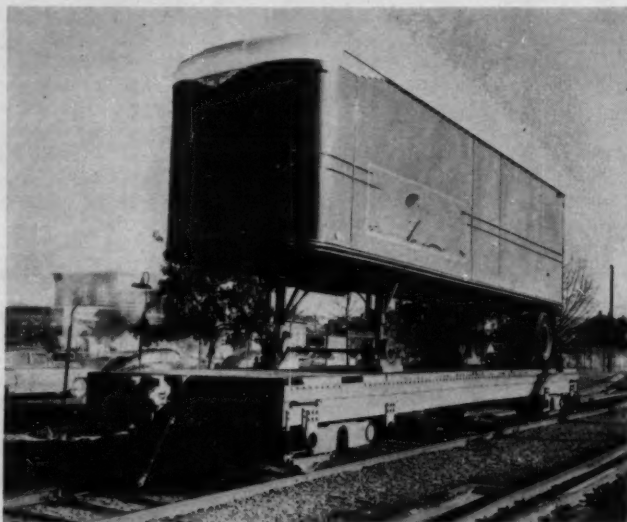
8-page booklet on
"Federal Specifi-
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16-page booklet on
Glycerine properties
and applications

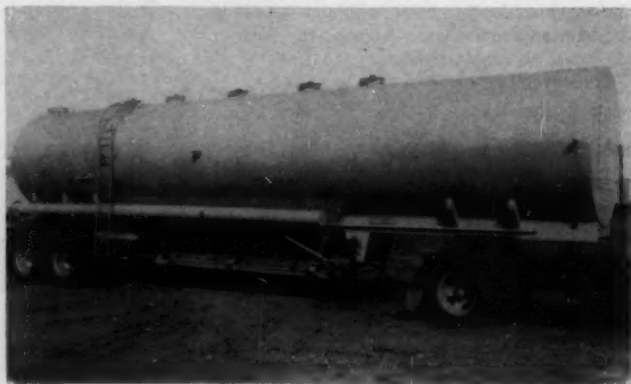
For your free copy of any or all of these booklets write: GLYCERINE PRODUCERS' ASSOCIATION • 295 Madison Ave., New York 17, N. Y.

What's New in Bulk Transport . . .



Completely new railroad freight car has basic "all-in-one" design. Car can serve in box, container-hopper, gondola, tank, hopper or "piggy-back" service by interchanging removable superstructures on the bed. Basic unit is a 35-ft. flat car mounted on single-axle trucks. Wheels run on roller bearings. Car weighs less than $\frac{1}{2}$ the weight of conventional cars,

yet has 70% the capacity, actually carries three times its own weight. Through easy loading, unloading and convertibility, idle time of cars is slashed at terminals and sidings. Automatic leveling valves keep platform loading height constant, regardless of load.—ACF Industries, Inc., 30 Church St., New York 8, N. Y. 242A



Bulk trailer for dry granular chemicals has built-in pneumatic system to unload lading directly into customer's storage. A Vacu-Veyor pneumatic conveyor is mounted at front end of trailer with conveying line running beneath hoppers to rear end. Tank is pressurized equal to conveying

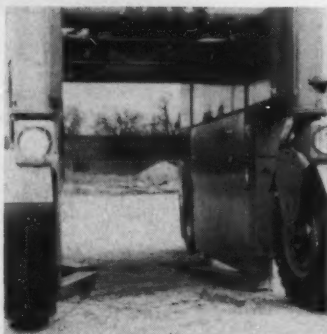
line, thereby eliminating rotary valves, screw conveyors and canvas belts. Only moving parts are motor and blower. Solids discharge at 22-ton-per-hr. rate. Trailer accommodates 17-20 tons. Mild steel tank is plastic lined.—Vacu-Blast Co., Inc., Belmont, Calif. 242B

Steel Drums

Soon generally available with conditioned surfaces.

Within the near future all J&L container plants will be manufacturing 55-gal. drums with conditioned protective surfaces. Four plants already in production on the JaLizing process will be joined in the near future by two remaining plants.

JaLized drums are completely laundered and dry. They have a protective coating which increases adherence and durability of paint surfaces. For clear liquid, non-corrosive products the zinc phosphate coating is sufficient without further painting.—Jones & Laughlin Steel Corp., 3 Gateway Center, Pittsburgh 30, Pa. 242C



Straddle Carrier

Has pivoted load hooks that swing in from side.

A straddle carrier has been introduced with load hooks which pivot in toward center from each side.

In place of conventional rigid load hooks, the new carrier has four forks, two on each side, which swing in at right angles and meet in the center to form two arms under the load. Since the hooks extend under the full width of the load, no bolsters are needed. Permanent skids or stringers are required only at the pickup and delivery points.

Carrier is available in six models to carry loads ranging in height from 48 to 66 in. and in width from 40 to 52 in. Capacity is 10 tons.—Ross Carrier Div., Clark Equipment Co., Benton Harbor, Mich. 242D

- Soap solution • Calcium hypochlorite •
- Water containing abrasive particles • Carbon slurry • Ferric hydroxide •
- Soap solution containing sand and ground glass • 25% grape juice concentrate •
- 50% caustic soda • Ferric sulphate • Ammonium sulphate • Demineralized water •
- Trisodium phosphate • Reactivated carbon • 1% chlorine solution • Sulphuric acid •
- 10% chromic acid • Humic acid •
- Waste sulphite liquor • Bleach liquor •
- Acid mine water • Liquid latex •
- Alkylaryl sulfonate •
- Sodium hydroxide •
- Calcium hydroxide •
- Calcium bisulphite •
- Calcium hypochlorite •
- Demineralized water •
- Weak black liquor •
- Slurries

*One pump handles all
these problem liquids*

DE LAVAL CPO PROCESS PUMP WITH KK-20 STAINLESS STEEL

CAPACITIES TO 2,000 GPM
HEADS TO 200 FT.



The De Laval CPO Process Pump has stainless steel parts where it comes in contact with the liquid. The casing, end head, stuffing box, impeller, seal ring and gland are all of De Laval KK-20 (20-28 stainless with molybdenum and copper). The shaft and lock nut are made of other

suitable stainless steels. • Three bearing pedestals accommodate nine wet end sizes. Off-the-shelf parts in ferrous and non-ferrous combinations permit changing size or metallurgy after installation. CPO pumps are available with both conventional packing and mechanical seals.

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1125-B

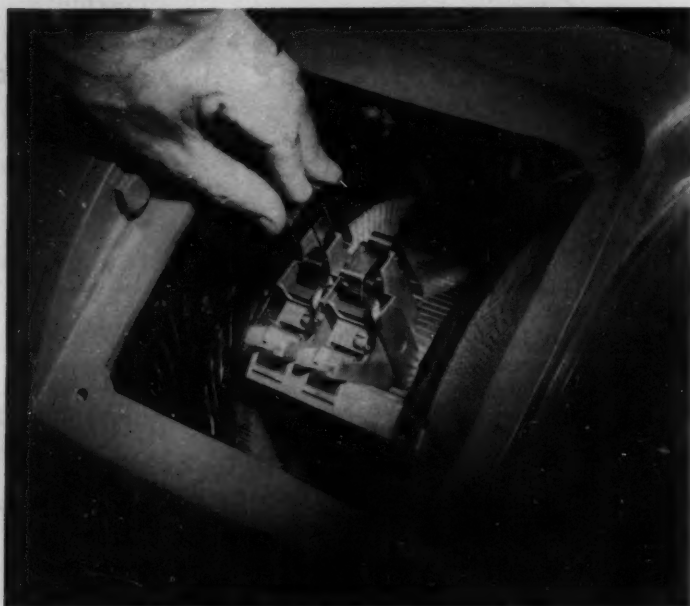


DE LAVAL Centrifugal Pumps

DE LAVAL STEAM TURBINE COMPANY

803 Nottingham Way, Trenton 2, New Jersey

DL-881



EASY access to brush rigging simplifies maintenance.

New Motor, Sharper Control

Completely new line of d.c. equipment is built specifically to utilize the feedback control principle. Offers more precise control of speed.

Use of d.c. electric drives to vary speed precisely gets an undenied boost with introduction of the Kinamatic line of industrial d.c. motors and generators.

New line features exceptional versatility in contrast to older designs. Easy maintenance, split-second response, improved performance and attractive appearance are other benefits.

Kinamatic equipment is reported to be the first complete line built to the latest NEMA standards for future design. Available immediately are all motor ratings from one to 150 hp. and all generator ratings from $\frac{1}{2}$ to 100 kw.

► **Where D.C. Stands**—There are well-founded claims that the d.c. motor drive is unsurpassed as a universal source of precisely controlled adjustable speed. It can develop vast

amounts of power, operate over wide speed ranges, accelerate and decelerate rapidly.

Yet its most important trait may be acceptance of regulation from sensitive electronic, magnetic and rotomagnetic controls.

Even so, in the postwar era need has increased for an entirely new design standard to keep pace with the requirements of automatic processing. Kinamatic design now updates designs and standards that have remained virtually unchanged for a quarter century.

► **Versatile**—New line is designed for use in all industries on an extremely wide variety of applications. NEMA standards have been surpassed to allow wider speed ranges and greater choice of speed with only $\frac{1}{2}$ as many machines as previously.

Because of versatility, motors can be switched from one job to another. Inventories of spare motors and parts can be smaller, therefore.

Through adoption of a new Class B insulation system and improved ventilation, motors are more compact and powerful. Horsepower per pound is up an average 33%.

Since machines are smaller, armature inertia has been slashed an average 35%. Result is faster response that is needed where motors must start, stop or change speed frequently.

► **Low Maintenance**—One factor in low maintenance is good protection. Standard Kinamatic motors and generators have dripproof enclosures. Ratings are designed to operate in this enclosure with a temperature rise of 60 C. so that a 15% service factor is available for extra capacity. Splash-proof and totally enclosed machines are available also.

Incorporated in the Class B insulation system are glass and mica. Field coils with a ground insulation system of mica mat and glass are encapsulated with a polyester compound to seal against moisture, dirt and other contaminants.

Brush rigging is designed to help the brush ride smoothly on the commutator with even pressure. Design of brush spring permits easy removal of brush.

► **Accessories**—Many times motors must have tachometers, speed limit devices, brakes, blowers and other accessories. Since the basic Kinamatic design allows for these they usually can be added to machines without further modification.

With the Kinamatic line now available to American industry there may be greater chance of reaching the goal of complete utilization of variable speed

For More Information . . .



about any item in this department, circle its code number on the Reader Service

Postcard inside the back cover.

Gyratory Screen

Produces Soda Ash for Glass Making

...ars. glass makers
money in the manufacture of soda
ash, according to Mathieson Chemical
Corp.

Using this machine, Mathieson is producing a new coarse light soda ash product suitable for glass making. The new product, Mathieson believes, could eventually supersede "dense" soda ash heretofore generally used by glass plants.

To produce coarse light soda ash, Mathieson is completing a plant at its Saltville, Va., location that will produce 50,000 tons per year. It starts operating this fall. The new soda ash from this plant will be offered in bulk carload lots at \$28 per ton f.o.b. Saltville.

To further the development and make the product available to all glass makers, Mathieson has revealed that the new ash is made with a machine that has been used by the milling industry for years to sift flour. The device is a dynamically balanced gyratory sifter, and Allis-Chalmers furnished the sifters for the new soda ash plant at Saltville.

The coarse light ash has been used in the commercial production of glass, and large-scale tests in glass plants show it to have all of the necessary physical properties to make good glass.

After gaining operating experience in the new Saltville plant, Mathieson expects to install additional facilities for producing the new coarse ash.

Reproduction of article in Chemical Engineering

You can use an all-metal gyratory *Circle* sifter to separate dry granular products into two, three or four predetermined sizes. Silk or metal cloth screens of 2 to 350 mesh may be used.

FOR MORE INFORMATION about *Circle* sifters or other Allis-Chalmers equipment for your industry, call your nearest A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

Circle is an Allis-Chalmers trademark.

- Eliminates need for soda ash densifying plant
- End product has all the physical properties needed to produce quality glass
- Enables manufacturer to offer finished product at lower cost

**GYRATORY
CIRCLE
SIFTER**

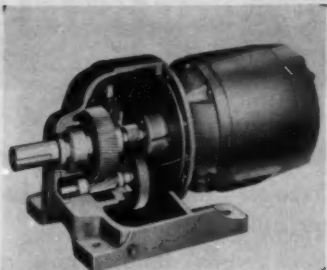
This is just another example of how Allis-Chalmers equipment is helping solve today's chemical processing problems.



A-4329

ALLIS-CHALMERS

wherever it offers benefits. GE points to a potential 10% boost in national productivity if this goal could be realized.—**General Electric Co., Direct Current Motor and Generator Dept., Erie, Pa.** 244A



Gearmotor

New sizes deliver more hp. per lb.

In keeping with the new NEMA motor sizes, a new line of Gearmotors and Motogears delivers more horsepower per pound. Units offer functional design without unnecessary size and weight.

Compactness results from a unique arrangement of hardened gears. Because of precision machining and use of rugged cast iron housings, drives operate quietly. Design also is oil-tight.

Rated in accordance with AGMA standards, Gearmotors range up to 30 hp and Moto-gears to 60 hp. Output speeds range from 280 down to 6 rpm.—**Link-Belt Co., 307 North Michigan Ave., Chicago 1, Ill.** 246A

Reduction Pulley

Claimed to reduce need for auxiliary gear reducers.

Greater compactness, lower cost, improved performance and simplicity of installation are advantages offered by a new reduction pulley, it is said. Unit looks like an ordinary V-belt pulley, yet has built-in gear reduction ranging from 7:1 to 700:1 in standard units and up to 8,000:1 on special order.

Pulley can be supplied as a plain speed reducer with friction clutch. Or it can be furnished as a two-speed, clutch controlled

reducer with either forward or reverse operation.

Overload release is standard. Installation usually requires only mounting on shaft and locking in place with taper lock bushing.—**Hart Reduction Pulley Co., 426 West Main St., Waukesha, Wis.** 246B

Speed Reducer

Now available in units for heavier jobs.

Through addition of two new models, maximum rated horsepower of the Torque-Arm line of speed reducers has been boosted 40%. Line now offers capacities from 1 to 60 hp. with output speeds from 12 to 365 rpm.

New No. 8 model with 60-hp. capacity can be mounted on shafts up to 5-in. dia. In common with other Torque-Arm models this large unit requires no foundation, no flexible couplings or sliding base. Unit is protected against overload by the Tri-Matic release which loosens belts, cuts off power and gives a warning.—**Dodge Mfg. Corp., Mishawaka, Ind.** 246C



Sealed Motor

For difficult ambient conditions.

Moisture, dust- and explosion-proof qualities have been built into a recently announced electric motor by enclosing the entire motor within a steel case filled with mineral oil. Motor is designed for mechanical drives and comes in wide selection of models and sizes to cover the 20-450 hp. range.

Motor can be supplied to meet special torque requirements,

horsepower and speed. Also, it can be designed for most advantageous mounting with shaft length as specified.—**Byron Jackson Pumps, P. O. Box 2017A, Terminal Annex, Los Angeles 54, Calif.** 246D



X-Rayed Object on TV

What x-ray reveals is shown remotely on TV.

Considerably lower cost for industrial x-ray inspection with visual indication is expected for a new television x-ray system. Using a newly developed pickup or x-ray camera tube the system eliminates need for combinations of fluorescent screens, costly lens, phototubes and studio camera tubes found in other TV x-ray intensification systems.

X-ray beam passes through object being examined and strikes a photo-conductive layer of lead oxide inside TV pickup tube. Low speed, 250-v. electron beam scans latent image on lead-oxide layer, amplifies it electronically and presents image on TV viewing screen.

Because image is intensified electrically, original x-ray voltage and intensity can be decreased to cut hazard.

For penetration of dense objects, such as steel up to 2½ in. thick, high x-ray voltage can be used.

While system has been operating industrially for more than a year, it is still considered to be in the development stage. A wide range of applications is expected to open up as development progresses.—**General Electric Co., X-Ray Dept., 4855 Electric Ave., Milwaukee 1, Wis.** 246E

Pelleting Solves Many Processing Problems

More and more processing engineers are profitably solving many problems by observing the following basic fact:

Multiple benefits are gained by forming a hard "shell" around materials and compressing them so that the surface areas are reduced.

This is accomplished through pelleting, which can be successfully applied to ammonium chloride, insecticide dusts, clay, citrus meal for use as an antibiotic carrying agent, fertilizer, granular hygroscopic products, and many other materials.

Pelleting reduces or eliminates the dusting characteristics of materials.

Pelleting helps preserve original moisture content, chemical analysis, and other properties.

Pelleted materials flow freely ...can be binned, sacked, and packaged easily.

Hard, shiny pellets have greater sales appeal than loose material.

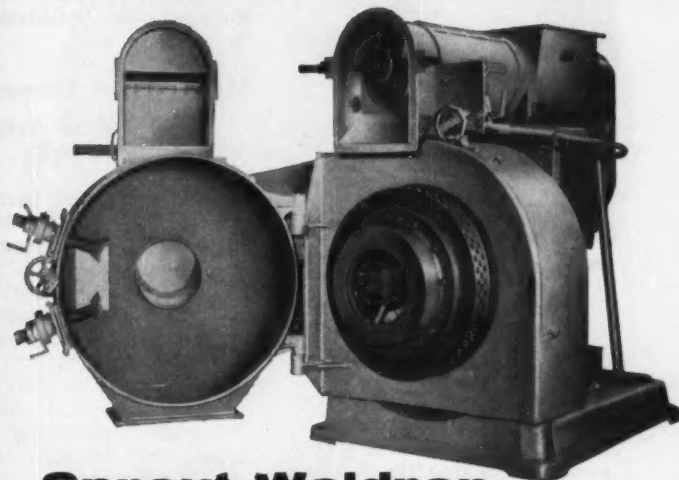
Densifying materials-in-process through pelleting improves their filtering qualities, permits granulating, and decreases dispersion rate. It also greatly increases density, facilitating storage and shipment.

You can quickly discover if pelleting can improve your products or processes by consulting a Sprout-Waldron field engineer. He offers reliable guidance on installations and applications. His recommendations are based on long experience and are backed by case history files of hundreds of successful pelleting applications and laboratory tests. Please write for an interview.

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**For top quality pellets
in tremendous volume
at low operating cost-**



Sprout-Waldron CONTINUOUS PELLETER

For Example:

The Sprout-Waldron Continuous Pelleter can produce pellets 3/16" in diameter and 1/4" long from some materials at capacities of 10 tons or more per hour with only 75 h.p. Small and large pellets can be produced in many sizes and shapes. Even 1" cubes are possible.

Such output and low power requirements are unequalled in the field and the original investment for a Sprout-Waldron Pelleter is most reasonable. A smaller size model is also available. Write for full details.

Compare these advantages with all other pelleters:

- Quiet V-belt drive.
- Exclusive hinged die casing for easy access.
- Corrosion-proof, stainless steel construction of feeder-conditioner and spout.
- Revolving die cover and material-lifting flights assure long life ... greater capacity.
- Entire mill uses only 4 standard main bearings. Over-all height, only 5 ft.

SPROUT-WALDRON

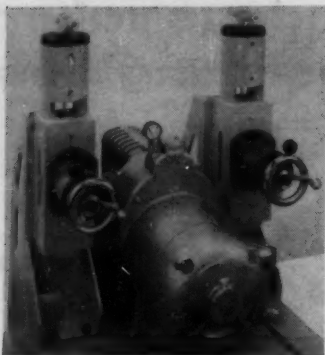
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Facilities for fabricating, machining, custom founding, woodworking, laboratory testing

PR/408



Proportioning Pump

Can be adjusted under full load up to 60,000 psi.

New Microflex, chemical-proportioning pump with a range of discharge pressures up to 60,000 psi. is said to offer longer pump and packing life. Reasons given are that main cross slide is in line with piston cylinder assembly, pistons are floating self-aligning type with shorter stroke length.

Piston stroke is adjusted by hand wheel over a 0 to 100% range. Irrespective of adjustment, piston reaches bottom of cylinder at every stroke setting. Length of stroke is shown on scale.

Pump is furnished with cylinder jackets for heating or cooling. External check valves are removed easily for inspection and servicing. In choice of simplex or duplex styles, pump capacities vary up to 32 gal. per hr.—American Instrument Co., Inc., Silver Spring, Md. 248A

Double-Ended Pump

With canned design for hard-to-handle liquids.

A recent variation of the Chempump design is the 3-hp., Series DE, double-ended unit. Basically, it is a two-stage pump. Liquid ends can be connected in series or parallel for remarkably compact high head or high volume pumping of process liquids.

Standard temperature and pressure limits of the pump are 450 F. and 300 psi. Already used extensively for pumping ti-

tanium tetrachloride, Series DE is available in cast iron, cast steel, 300-series stainless steel, Monel and Carpenter 20.—Chempump Corp., 1300 East Mermaid Lane, Philadelphia 18, Pa. 248B

All-Purpose Pump

Fabricated of Teflon for wide application.

With all wetted parts constructed of solid Teflon the Model 100-C diaphragm pump is completely inert to all chemicals and solvents except molten alkali metals and fluorine at elevated temperatures and pressures. Unit operates successfully from -50 to 300 F.

Pump is hermetically tight. There are no packing glands or rotary seals to leak irritating or obnoxious fumes.

Vapor, gas or air can be handled up to approximately 10% of capacity without losing prime. There is sufficient dry lift to eliminate initial priming.

Capacity is 300 gph. at 1.0 sp. gr. and total head of 12 ft.—O. K. Machine & Tool, Inc., Waco, Tex. 248C



Leakproof Pump

Available in wide range of sizes with flexible variations.

Two new lines of leakless general purpose centrifugal pumps are now available. General design of the Electri-Cand pump, Chem. Eng., Feb. '54, p. 288, is based on the canned motor principle where both pump impeller and rotor of motor rotate in the liquid being pumped.

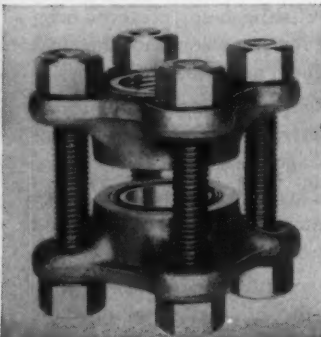
Electri-Cand pumps are built in a fractional horsepower line, C-10, to include motors through 2 hp., and an integral horse-

power line, C-11A and C-11B, covering motors above 2 hp. Pumps can handle heads to 250 ft., temperatures to 250 F. and capacities to 500 gpm.

Type C-11A integral horsepower pumps have long-lived fluid piston radial bearings throughout. Special design can be applied to overcome any heat added to the stator by hot liquid.

Pump C-11B does not have any external piping and uses less costly carbon-sleeve radial bearings. The fractional horsepower line also uses the carbon sleeve radial and thrust bearings.

Manufacturer reports that pumps for any application within the range of the two lines can be tailor-made from standard parts. This permits a flexibility not available previously in such equipment.—Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. 248D



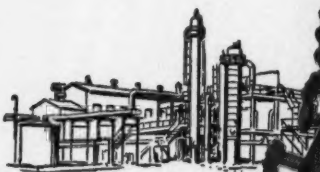
Flange Unions

With two or four bolts and O-ring seals.

A line of flange unions is now being offered with choice of two- or four-bolt design and O-ring seals. Used for process, water and refrigeration piping these flange unions seal tightly against fluid pressure.

Unions are rated for 3,000 lb. with both screw-end and socket welding types available. Two-bolt unions come in sizes from 1/2 to 1 1/2 in.; four-bolt model in sizes from 1 to 2 in. O-rings can be furnished in a variety of materials.—Watson-Stillman Fittings Div., Roselle, N. J. 248E

HOW STAINLESS STEEL
*brings a whole set
of advantages
to critical
processing jobs*



This 60-inch diameter nitric acid absorber tower typifies the application of stainless-steel in the chemical processing industry. Made by the Vulcan Manufacturing Division of Cincinnati, Ohio, it is an excellent example of how several properties of a specific type of stainless steel team up to solve a tough chemical processing problem.

The stainless that Vulcan chose for the all-welded body is Crucible Rezistal® Type 347. Here are three big reasons why:

High tensile strength to minimize structural support.

Stability against formation of harmful carbides, both during welding and in high-temperature operation.

Remarkable corrosion-resistance to withstand lasting exposure to nitric acid. It is fully resistant to the acid in diluted form at any temperature, and to concentrated solutions at lower temperatures. It is satisfactorily resistant to concentrated solutions above the boiling point.

Your operations may not call for nitric acid absorber towers, but if they include any critical phase of chemical processing, check the many advantages offered by the 30 available types of Crucible stainless steel. You'll find details in "Making the Most of Stainless Steels in the Chemical Processing Industry," which is yours free on request. And, to find out what information is available on the many other Crucible special steels, ask for "Crucible Publication Catalog." Or consult your nearby Crucible representative. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 22, Pa.*

CRUCIBLE

first name in special purpose steels

Crucible Steel Company of America

Hard Surfacing

Resists extreme vibration and heat.

Offering improved resistance to heat and vibration Colmonoy No. 70 is recommended for chemical valves, acid pump parts and for equipment that handles loose abrasives. Alloy owes its properties to a high tungsten content which hardens the matrix. Other constituents include nickel, chromium and boron.

Colmonoy No. 70 is available as a powder for spray-welding or as welding rod for application with an oxy-acetylene torch. Also, it can be furnished in the form of castings.—Wall Colmonoy Corp., 19345 John R St., Detroit 3, Mich. 250A



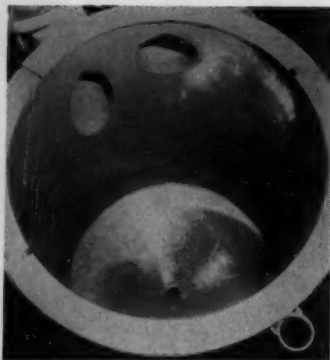
Pipe Covering

For low temperature lines.

New LT cork covering for all low-temperature lines offers the insulating efficiency, rigid strength and long life of molded cork covering. Yet it can be bought and installed at a much lower cost.

Covering is made from precision-cut segments of cork-board. It is available in three thicknesses for 30 F. or higher, 0 F. or higher and -30 F. or higher. Special thicknesses can be furnished for below -30 F.

In all thicknesses, the cork-board segments are backed by asbestos and aluminum laminated paper. A lap of the laminated paper at one edge of the covering provides longitudinal seal.—Armstrong Cork Co., Lancaster, Pa. 250B



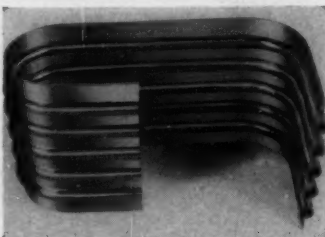
Lining Material

Protects carbon steel, cheaper than alloys.

A new fluorocarbon plastic laminate can be adhesive-bonded to almost any contoured surface. Many types of vessels, ranging from rectangular tanks to complex reactors, have been lined throughout with the material.

Laminate consists of 10-12 mil continuous layer of Kel-F plastic on glass cloth. After surface of steel has been cleaned and roughened the pre-cut laminate is cemented in place and held until the adhesive sets. Job is finished by sealing the seams and testing electrically for pinholes or incomplete seams.

Material is furnished in 36 by 46 in. sheets. Longer sheets can be delivered on special order.—Garlock Packing Co., Palmyra, N. Y.; U. S. Gasket Co., Camden, N. J. 250C



Formed-in-Place Tubes

Homogeneous combination of tubes and strip.

Considered ideal for heat exchange, new Tube-In-Strip material consists of single strips or sheets of solid copper, brass or aluminum. Nature of mate-

rial is such that it can be inflated to produce tubes in the sheet.

To the eye, Tube-In-Strip is no different from standard strips of rolled metal. However, expandable portions within the metal can be inflated into continuous running lengths either with compressed air or pressurized liquid. Size and spacing or combinations of these variables must be designated at time of ordering to be incorporated in manufacturing specifications.

Except for the expandable portions, metal is a solid strip derived from a treated casting.

Metal can be stamped or drawn into desired shapes prior to expansion of the channels. Actual expansion can be to natural circular shape or to other types of sections through use of dies. Also, it is possible to inflate one side of the channel only, leaving the other surface flat.

Major economies are predicted for the user because tube and strip is purchased as one item already fabricated to specified design. Shipping space is saved. New, improved designs are possible. Material even offers promise as a structural member that has built-in reinforcement.—Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y. 250D

Resurfacing Material

Patches concrete floors, columns, etc.

Erco-Crete is a new compound for patching concrete surfaces that produces a renewed surface stronger and more durable than the original concrete. It is suitable for both interior and exterior exposures, is completely resistant to all straight-chain hydrocarbons, ethylene, glycol, glycerine, naphtha and vegetable oils.

Compound consists of a liquid binder and a dry aggregate which are mixed before using. It can be laid down in thin sections, feathered out to fine edge and trowelled to a smooth finish with ease.—Earl Paint Corp., Utica, N. Y. 250E

"Why we use Crouse-Hinds
CONDULETS[®]
 at Pathfinder Chemical"



A
 NATIONWIDE
 DISTRIBUTION
 exclusively through
 ELECTRICAL
 DISTRIBUTORS

Clair Dean...

Engineering Manager at Buffalo Electric Co.,
 Electrical Contractor for Pathfinder Chemical Division,
 Goodyear Tire & Rubber Company explains:

"You find Condulet electrical equipment all over the Pathfinder plants — from complex explosion-proof instrument enclosures on the panelboard shown at left, to simple explosion-proof pulling elbows on the branch circuits at top. We like Condulet equipment because it installs easily, works right, and stays on the job for years without attention."

There are more than 15,000 items listed in the Condulet Catalog: conduit fittings, plugs and receptacles, motor controls, lighting fixtures, switches, hundreds of others, both explosion-proof and conventional. Make your selections with confidence. You get the best when you get Condulets.

Our distributors have the facts. Or contact a Crouse-Hinds Office below.

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pH Instrument

Measures continuously at high temperature and pressure.

Measurement of pH is handled continuously at temperatures up to 200 C. and pressures at 200 psi. using the CAE system. Accuracy is 0.05 of a pH unit and drift over 24 hr. is not over 0.1 on the pH scale.

Ranges giving a full scale deflection of either 0-5 or 0-10 pH are standard. Range may be located to cover any portion of the scale specified by the user.

Plug-in range units permit fast and positive change of the characteristic. No re-calibration is required.

Reference electrode, glass electrode and temperature-sensitive Thermohm device are housed within a stainless-steel flow unit. Output from the electrodes goes to an electronic transmitter. Output from the transmitter can go to a recorder and there is provision for tying in a controller.—Canadian Aviation Electronics, P. O. Box 630 Station "0", St. Laurent, P. Q. 252A

**Gas Alarm**

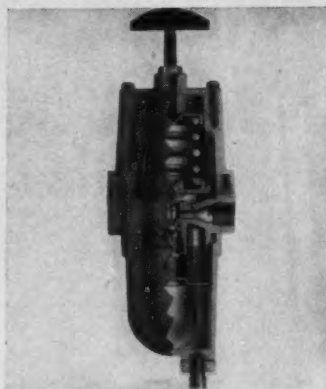
For hazardous areas is completely portable.

A completely self-contained portable analyzer and alarm system for combustible gases is designed for use in or near hazardous areas.

Unit is a continuous sampling system operated by motor-driven pump mounted inside. Features include visual and audible "high-gas" signals; large, readily visible meter calibrated 0 to lower explosive limit to show gas or vapor concentration at all times; built-

in "trouble-indicating" circuit with indicating light and audible signal.

Maintenance is extremely easy reports the manufacturer. System operates on 110-v., 60-cycle, single-phase power.—Davis Instruments, 47 Halleck St., Newark 4, N. J. 252B

**Air Regulator**

Controls small air or gas volumes.

New instrument air regulator, Type 73-26, features higher air volumes, improved corrosion resistance and a 40 micron phenolic-impregnated cellulose filter. It has minimum pressure drift from set point, gives instantaneous response to flow rate changes. Adjustment is easy within close limits for any pressure within output range.

Regulator can be mounted on panel or bracket and serviced without removing from air line. Maximum input pressure is 300 psig; maximum output pressure is 40 psig.—Black, Sivalls & Bryson, Inc., 7500 East Twelfth St., Kansas City 26, Mo. 252C

Potentiometer

Highly sensitive transmitting unit.

A new transmitting potentiometer, based on an entirely new operating principle measures and controls low voltages while drawing negligible current from the source. It is available as a thermocouple pyrometer or to measure direct-current output of electrical

transducers. When used with the American-Microsen Electronic Control system it controls temperatures closely.

Potentiometer uses no slide-wires, batteries, standard cell, "chopper" or converter. Transmitter is available in ranges from 6 to 50 millivolts with zero suppression up to five times the span. Output of 0.5 to 5.0 milliamperes d.c. can be transmitted up to 30 miles.—Manning, Maxwell & Moore, Inc., Stratford, Conn. 252D

Fail-Safe Monitor

Eliminates unsafe failure from control system.

Through a new technique the possibility of unsafe failure is eliminated from industrial control systems of the electrical, electronic or mechanical type. Concept has been applied to fire-detection systems, thermostat controls, liquid-level controls and various types of photocell devices.

Essentially, the Scully-Rowell fail-safe technique continually "exercises" the monitoring system to prove its operability.

A signal representing the normal condition of the operating system is introduced directly to the monitoring system. Periodically the monitoring system alters this safe operating signal to produce a simulated unsafe condition. Result is a continuous, oscillating safe-unsafe-safe condition.

If the normal operating signal fails, the oscillation changes to a continual unsafe condition which sounds an alarm. If the monitoring system fails, the resulting continual safe condition also actuates an alarm. So either way warning is given.

Frequency of the oscillation is determined by the speed with which alarm must be given following failure of the condition to be sensed. Slow-acting processes may require only one oscillation every few minutes. Others, such as combustion control systems or nuclear reactor controls must have an extremely high monitoring frequency.—Scully Signal Company, Electronics Div., Melrose, Mass. 252E

Case No. 58

Results Bring Re-Order
from Heyden Chemical
Corp. for Second Kemp
Inert Gas Generator

Heyden Chemical doubles its blanketing savings with Second Kemp Generator

HERE'S A CASE where simple mathematics paid big dividends at this Garfield, New Jersey plant. When Heyden Chemical—one of the nation's leading producers of formaldehyde, pentaerythritol, salicylic acid, etc.—installed its first Kemp Inert Gas Generator to furnish CO₂ for blanketing a special grinding operation, it was on more or less a test basis. Part of Heyden's constant search for newer, better, cheaper ways to improve its products. The rest of its blanketing needs were still being handled with CO₂ from large storage tanks in the plant.

Immediate Savings with Kemp

Results with the first Kemp Inert Producer were impressive. Now a second (see right) Kemp unit has been installed and actual savings over previous costs are estimated at over \$500 a month for the first year. In addition to dollars saved, Kemp Generators assure a safe, dependable supply of chemically clean inerts. Deliver inerts at a special analysis . . . without fluctuations.

Kemp Designs Versatile

If you still rely on old-fashioned inert sources or are dissatisfied with present inert equipment, let Kemp help you, too. Kemp Engineers will be most happy to help solve your inert problems . . . show you how you can get similar results with fast-starting, easy-to-operate Kemp Generators. It costs you nothing to investigate. And it may save you real money.

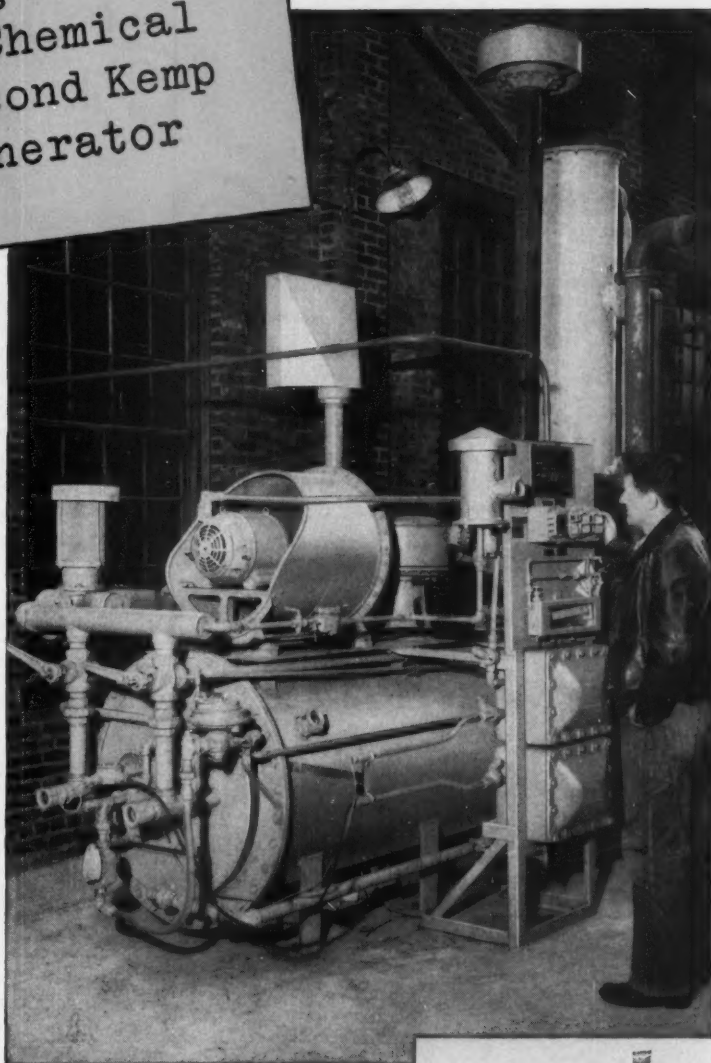
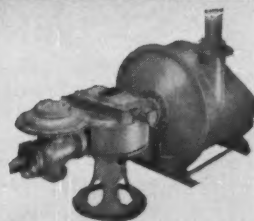
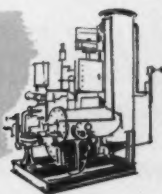


Photo at right shows close-up view of Kemp Industrial Carburetor. Part of every Kemp installation, it eliminates tinkering, waste. Assures complete combustion at all times. Reduces installation costs and maintenance.



For more complete facts and technical information, write for Bulletin I-10 to:
C. M. KEMP MFG. CO., 405 East Oliver Street, Baltimore 2, Maryland.

KEMP OF BALTIMORE

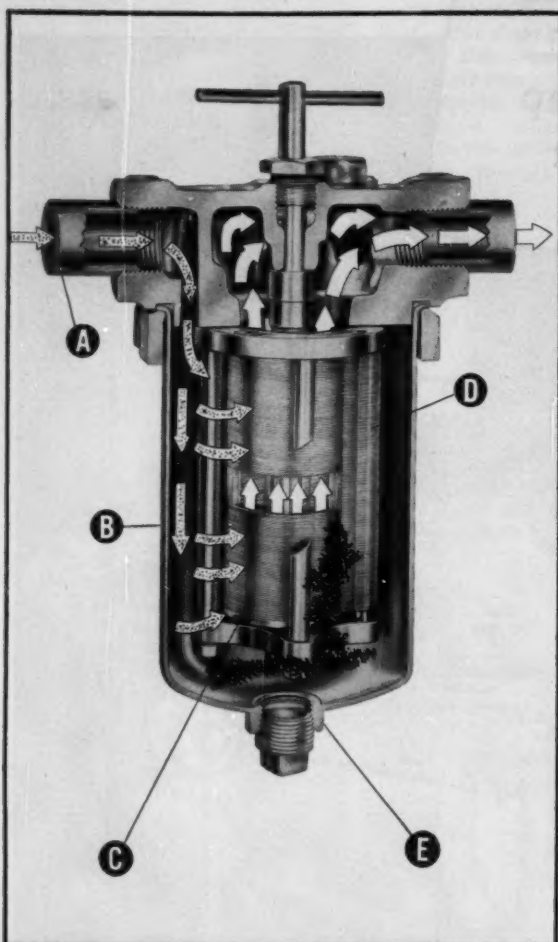


INERT GAS GENERATORS

CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • ADSORPTIVE
DRYERS • SINGING EQUIPMENT

New! CUNO SUPER Auto-Klean Filter

A 40-micron, self-cleaning filter for process liquids



HOW IT WORKS. Dirty liquid enters inlet (A) at left, fills housing (B) and flows through metal edge-type filter (C). Clean liquid rises through center of filter, leaves at right. Dirt combed out by cleaner blades (D) is removed through drain (E).

...and you can clean this filter by simply turning the handle!

Many times smaller than other micron filters of equal capacity, Cuno's new SUPER Auto-Klean filter now makes possible economical, micron filtration at high flow rates and eliminates the need for replacement cartridges. Here's what SUPER Auto-Klean offers process industries:

1. *Micronic filtration* with a self-cleaning filter. Just turn handle to clean—continuously with motor drive or intermittently by hand.
2. *Eliminates cartridge changes.* Ends operating costs if you've been using cartridge filters.
3. *No pressure-drop build up.* An 8-in. long, 2¼-in. diameter cartridge handles 30 gpm of liquid at 50-centipoise viscosity with only 3-psi pressure drop—up to 75% more with a slightly higher pressure drop.
4. *Positive protection* against solid particles larger than 40 microns (actually 0.0015-in.). Can't rupture or channel.
5. *Much smaller* than replaceable-cartridge-type filters of equal capacity, you save on lower initial costs, lower installation costs, lower space requirements than for cartridge units. You get high capacity in a small package.
6. *No duplex units needed.* Handles full flow all the time with no interruptions for cleaning.
7. *SUPER Auto-Klean* fits existing Cuno Auto-Klean housings. You can easily replace most 2¼-in. diameter cartridges with SUPER Auto-Klean for finer filtration.
8. *SUPER Auto-Klean* is available in all-steel or type-316-stainless-steel construction with Teflon seal.

WRITE TODAY for your copy of SUPER Auto-Klean Catalog SAK-057 or discuss your specific process application with our engineers. Cuno Engineering Corporation, 3-4 South Vine Street, Meriden, Conn. 5.10

Typical SUPER Auto-Klean installations

1. 50 gpm of organic solution, viscosity 100 to 130 cps at 80°C operating temperature and 125-psi operating pressure—40-micron filtration.
2. 1.2 gpm of polyethylene, viscosity 50,000 cps at 340°F, operating pressure of 2,000 psi and pressure drop of 800 to 900 psi—40-micron filtration.
3. 10 gpm of resin, 2,000 SSU at 500°F and 100-psi operating pressure—40-micron filtration.
4. 10 gpm of printing ink—40-micron filtration.
5. 20 gpm of coating liquid—40-micron filtration.
6. Phenolic water at 125-psi operating pressure on pumps—40-micron filtration.
7. 150 gpm of wax—40-micron filtration.

Ideal for in-line installation before pre-coat filters.



ENGINEERED FILTRATION

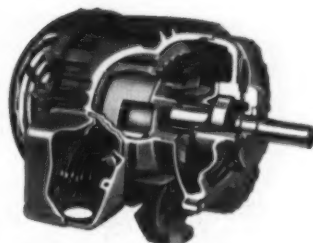
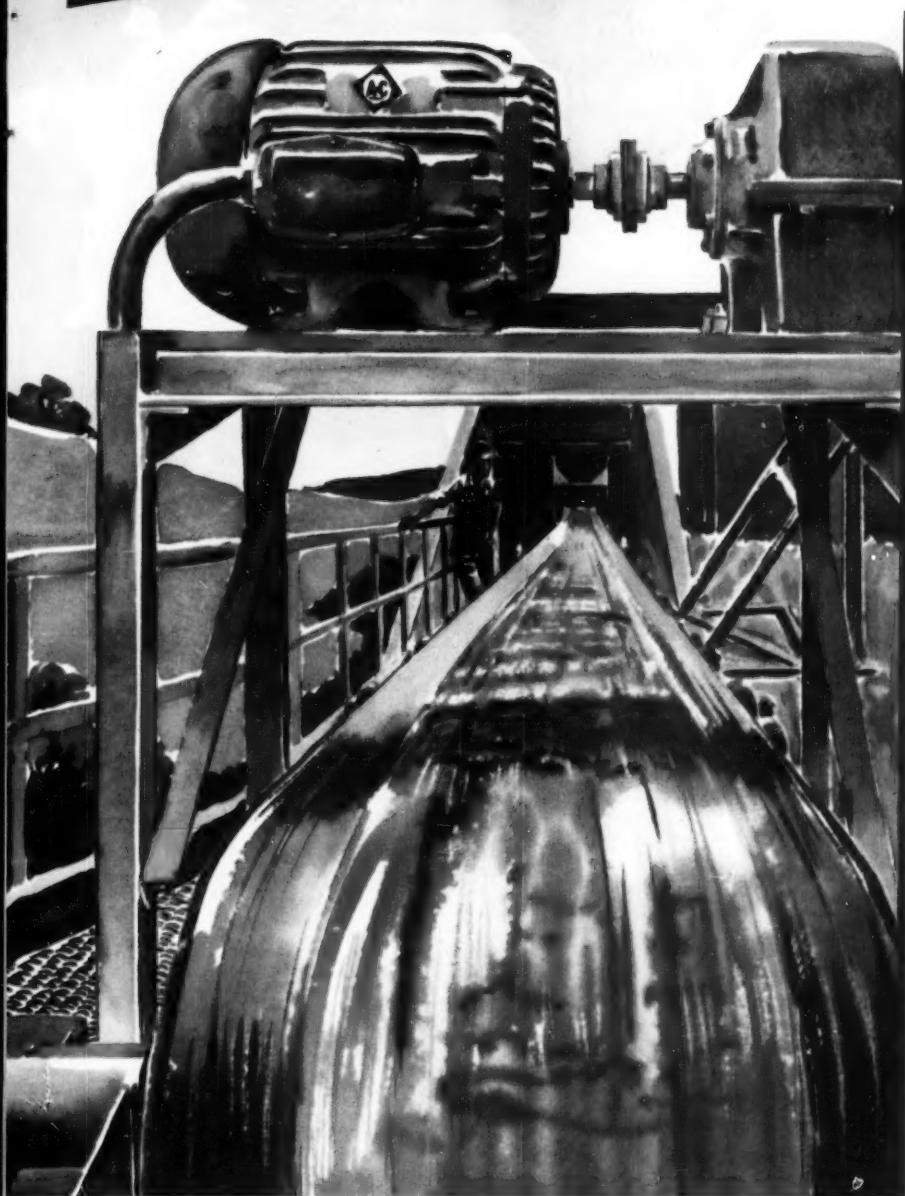
Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (edge-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound) • PORO-KLEAN (porous stainless steel)

**There's
MORE**

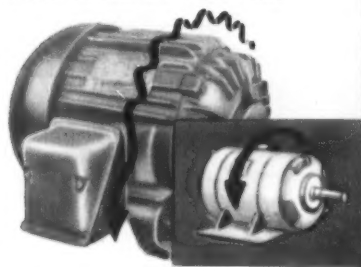
*'Round-the-Calendar
Operation*

**with Allis-Chalmers
MOTORS**



MORE IRON AND COPPER

provide double protection against costly breakdowns. Liberal use of cast iron protects against frame distortion, and greater amount of copper increases electrical life.



MORE COOLING SURFACE

of Allis-Chalmers deep-rib motors makes insulation burnouts highly improbable under normal conditions. There are no external enclosed air passages to become clogged.



A NATIONAL NETWORK

of Allis-Chalmers Motor Distributors is on the job day and night... ready to provide the fast service needed to keep your plant operating 'round-the-calendar.

As a new machinery component or as replacement, specify Allis-Chalmers motors. To find out more, contact your nearby Allis-Chalmers district office, your A-C distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

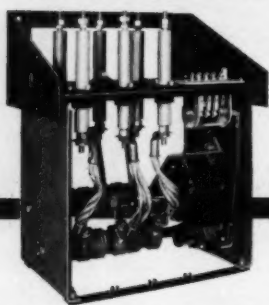
ALLIS-CHALMERS



A-4906

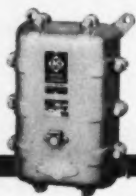
These Safety Features

meet operating demands of
combustible atmospheres



Oil-immersed main contactor for safe operation

The complete contactor, including magnet and auxiliary switches, operates under oil to prevent sparks from igniting atmosphere and to protect mechanism from corrosion.



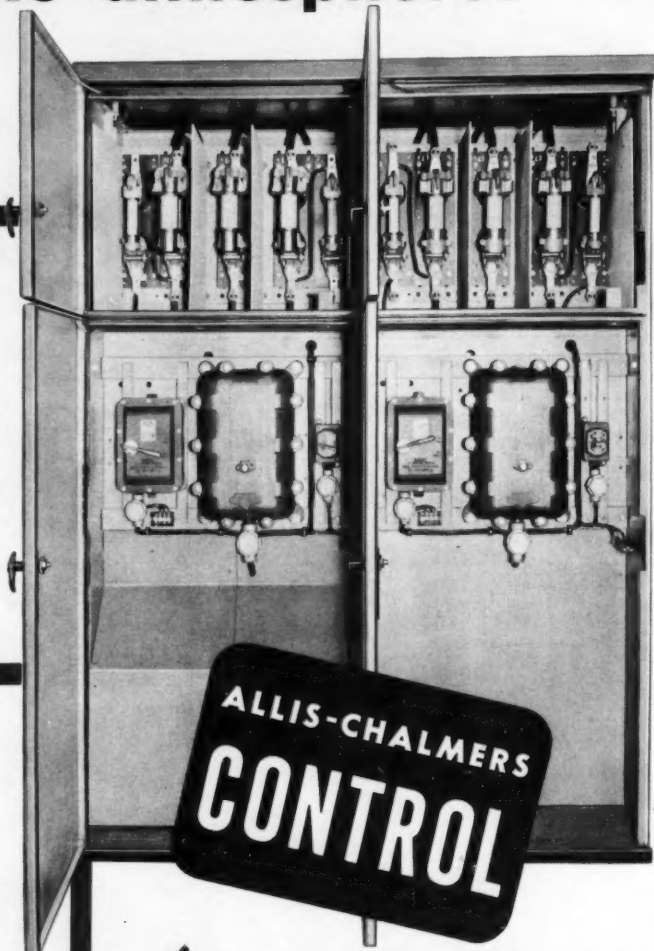
Relays and switching devices in explosion-proof cases

Further protection against the possibility of explosion is provided by NEMA VII enclosure which houses all overload, under-voltage, timing and auxiliary control relays as well as other low voltage switching devices.

Interlocked fuse compartment door

The fuse disconnect door is interlocked. The line contactor must be opened before access to the fuse is possible.

Other features *Steel barriers* in rear compartment prevent accidental contact with high voltage parts. Enclosure is finished with corrosive-resistant paint. Indoor or outdoor control equipment may be provided.



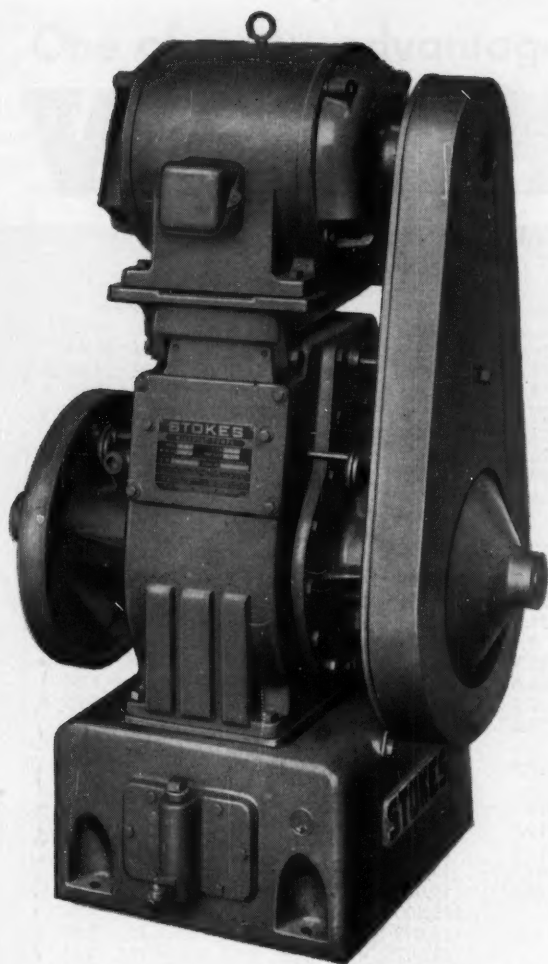
Industry-Engineered
for Semi-Hazardous Locations

Type H starters for 2300 to 5000-volt motors

For complete information,
see your Allis-Chalmers rep-
resentative or write Allis-
Chalmers, Milwaukee 1, Wis.



ALLIS-CHALMERS



DEPENDABLE, LOW-MAINTENANCE, VACUUM PUMPING

Stokes vacuum pumps remain the standard of comparison for reliable, low-cost performance.

Here's the answer to your high vacuum problems . . . for pilot plant or for production processes. Pump design, based on Stokes pioneering experience in high vacuum equipment, incorporates outstanding features to assure trouble-free performance . . . versatile application.

Minimum maintenance. New mechanical face seal ends oil leakage at the shaft. No stuffing boxes. Fully automatic lubrication.

Wide application. New exhaust valve stops with double springs assure trouble-free operation during extended pumping periods from high to low pressure ranges.

Dirt troubles prevented. New intake screen filter traps dirt, scale and other damaging solids. When necessary, every part of the pump is readily accessible for cleaning.

Extra protection. New oil filter in the line supplies added protection to bearings and shaft seal.

Fail-safe design. If power should fail, a solenoid in the oil line prevents oil flooding of the pump and vacuum system. Microvac pumps offer highest efficiency over entire pressure range . . . are also widely used as high speed fore-pumps in conjunction with booster and diffusion pumps. Write for: Catalog 751, information on vacuum pumps and pumping problems; Stokes' slide-rule vacuum calculator; Booklet 755, "How to care for your vacuum pump" . . . or call your nearest Stokes office. F. J. Stokes Machine Company, Vacuum Pump Div., 5507 Tabor Rd., Philadelphia 20, Pa.

specialists in high vacuum

STOKES

Chemical Economics

EDITED BY D. R. CANNON

Chemical Processors Scored Profit Pluses All Down the Line

	Sales (Thousand Dollars)			Post-Tax Net Profits (Thousand Dollars)			Earnings Per Share	
	1955	1954	%	1955	1954	%	1955	1954
Air Reduction.....	149,232	123,315	+21.0	11,569	6,338	+82.5	\$3.54	\$1.86
Allied Chemical & Dye.....	628,514	530,777	+18.4	52,128	43,072	+21.0	5.72	4.80
American Cyanamid.....	451,088	397,592	+13.3	38,714	27,050	+42.8	4.07	2.95
American Marietta ^a	165,340	120,725	+37.0	11,110	5,466	+103.3	3.63	1.93 ¹
Carborundum.....	89,830	71,898	+24.9	5,187	3,284	+57.9	3.01	1.92
Dayton Rubber ^b	69,150	55,924	+23.6	2,321	1,152	+101.5	3.77	1.80
Devco & Reynolds ^a	52,929	48,008	+10.3	2,176	1,334	+63.1	4.01	2.45 ²
Dow Chemical (Six months) ^a	272,971	222,097	+22.9	28,340	16,552	+71.2	1.22	.71 ¹
E. I. du Pont ^a	1,890,000	1,687,650	+12	426,000	344,386	+24	9.26	7.33
Freeport Sulphur.....				12,401	10,084	+23.0	4.96	4.20
Gulf Oil ^c	1,524,312	1,379,734	+10.5	166,768	143,088	+16.5	6.26	5.37
Hercules Powder.....	226,651	187,548	+20.8	19,012	14,140	+34.5	6.90	5.10
Hooker Electrochemical.....	94,182	77,517	+21.5	10,555	8,202	+28.7	1.72	1.36
International Minerals.....	21,633	22,282	-2.9	1,314	1,444	-9.0	.52	.58
Koppers.....	230,261	188,305	+22.3	10,415	6,125	+70.0	4.92	2.77
Lee Rubber & Tire ^b	45,912	39,385	+16.6	1,750	1,400	+25.0	2.06	1.66 ⁴
Marquette Cement.....	39,561	37,501	+5.5	6,115	5,121	+19.4	2.26	2.08 ⁵
Monsanto Chemical ⁶	522,349	341,823	+52.8	42,170	23,701	+77.9	1.98	4.39
Nopco Chemical.....				1,536	1,324	+16.0	3.05	2.66
Norwich Pharmacal.....	24,827	20,794	+19.4	2,772	2,042	+35.7	3.01	2.27
Olin-Mathieson Chemical ^a	560,000	470,108	+19	45,000	34,291	+31	3.40	3.02
Owens-Corning Fiberglas.....	161,294	136,470	+18.2	10,945	8,412	+30.1	3.48	2.68
Phillips Petroleum ^a	900,000	786,000	+14.5	95,000	76,000	+25.0	5.54	5.20
Rayonier.....	142,500	86,900	+64.0	15,900	11,860	+34.1	2.86	2.05 ⁷
St. Regis Paper.....	257,000	200,090	+28.4	19,000	14,931	+27.3	2.59	2.62
Shell Oil.....				125,500	121,000	+3.7	4.56	4.40
Smith, Kline & French.....	91,675	65,357	+40.3	16,023	9,336	+71.6	3.31	1.93
Sun Oil.....				48,307	40,344	+19.7	4.72	4.17
Union Carbide & Carbon.....	1,187,153	923,693	+28.5	140,756	89,779	+56.8	4.83	3.10
West Virginia Pulp & Paper ^b	176,237	164,843	+6.9	15,724	13,096	+20.1	3.08	2.57

* Estimated; (n.a.) not available; (a) Fiscal year ends Nov. 30; (b) Ends Oct. 31; (c) 10 mo. total (1) 2-1 stock split (2) Class A common; (3) After dividends on preferred, now retired; (4) 3-1 stock split; (5) 2½-1 stock split; (6) Figures not comparable due to merger with Lion Oil; (7) 2-1 stock split.

Chemical Profits in '55: the Big Payoff

In the forefront of a racing economy, chemical processing industries missed few steps as they pounded to stunning records in sales and profits for 1955.

William Chartner, McGraw-Hill Dept. of Economics

Chemical process industries had a banner year in 1955. Early reports from a broad sample of companies point to all-time records in both sales and profits. Net sales up approximately 13% over the 1954 total of \$58.3 billion, and profits after taxes showed a stunning 23% increase

over the \$5.1 billion of 1954.

Why did the rise in sales, imposing as it was, bring an even bigger spurt in earnings? The two big reasons:

• Producers reaped benefits from heavy expenditures in recent years for new and more efficient equipment.

• Higher production rates permitted most companies to operate more profitably than in the recession year of 1954.

The financial totals for the process industries should shape up something like this when final figures are in from the Federal Trade Commission and Securities and Exchange Commission.

Chemicals and Allied Products—Net sales up 13% over the record \$17.5 billion of 1954; profits before taxes up about 37% from \$2.3 billion; profits after taxes up about the same

One of many advantages of 90/10 Cupro-Nickel **WELDABILITY**



Welding head on filter shell

One of the relatively new copper base alloys is 90/10 Cupro-Nickel, which is coming into increased use as a result of experience with it. Revere offers it in sheet and plate, pipe and tube. It is highly resistant to corrosion and erosion, particularly in salt or brackish water. In addition it can be cold or hot worked, welded, soldered and polished. Because its nickel content is less than the older 70/30 alloy, it is priced lower.

The item shown here is a 90/10 Cupro-Nickel filter for aviation gasoline, designed and fabricated by the Warner Lewis Company, Division of Fram Corporation, Tulsa, Oklahoma, for the U. S. Navy. Heads and shell are $1\frac{1}{8}$ " thick. Revere was given the opportunity to collaborate with the Warner Lewis manufacturers on welding, which was successfully accomplished by the metallic arc process, using Inco 70/30 Cupro-Nickel electrodes. The vertical weld on the shell was X-rayed 100% and found satisfactory to pass Navy inspection. Because of the thickness of the metal, it was decided to form the heads hot at around 1690° F. The forming was done by the Hackney Iron & Steel Co., Enid, Okla., which also consulted with Revere.

Warner Lewis Company of Tulsa, with representatives in 30 cities, are specializing on all types of alloy design and fabrication and inquiries of this nature are invited.

If you wish information regarding the selection, welding, or working of copper and its alloys and aluminum alloys, see the nearest Revere Sales Office.



Completed aviation gasoline filter,
made of 90/10 Cupro-Nickel

REVERE
COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N.Y.

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.;
Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.—
Sales Offices in Principal Cities, Distributors Everywhere.

percentage from 1954's \$1.2 billion.

Paper and Allied Products—Net sales up 15% over 1954's \$8.5 billion; profits before taxes up a third from \$970 million in 1954; post-tax profits up a fourth from \$600 million in 1954.

Petroleum Refining—Net sales up 10% over 1954's \$21.1 billion; pre-tax profits up 12% from \$2.8 billion in 1954; profits after taxes higher by 9% than 1954's \$2.2 billion.

Rubber Products—Net sales 20% better than the 1954 total of \$5 billion; pre-tax profits up 42% from \$393 billion; post-tax earnings almost a third better than 1954's \$200 million.

Stone, Clay and Glass Products—Net sales 18% higher than the \$6.3 billion in 1954; profits before taxes up almost 50% from \$883 million in 1954; profits after taxes up about 45% from \$466 million in 1954.

Among the early-reporting companies hefty sales increases were recorded by American Marietta (up 37% over 1954), Carborundum (up 25%), Rayonier (up 64%), Smith, Kline & French (up 40%) and Union Carbide & Carbon (up 28%).

There were still bigger jumps in earnings reports. Post-tax profits were doubled by American Marietta (up 103%) and Dayton Rubber (up 101%). Others with large earnings gains included Air Reduction (up 82%), Devoe & Reynolds (up 63%), Dow Chemical (up 71%) and Smith, Kline & French (up 72%).

Very few companies showed lower sales or lower earnings than in 1954. Those that did were generally victims of special circumstances. International Minerals & Chemical, for instance, was hurt by a four-month strike in Florida.

► **Regular Depreciation Rose**—Profit figures would have shot up even more spectacularly except for sharp increases in depreciation charges, a reflection of heavy investment by chemical process companies in new plant and equipment. For the entire industry group, depreciation and depletion charges rose almost 18%—from \$2.8 billion in 1954 to \$3.1 billion in 1955.

If depreciation charges had been the same in 1955 as in 1954, pre-tax profits would have been up by 30% instead of the actual rise of 23%. However, depreciation charges serve a purpose similar to that of retained profits in providing internal cash for a company. So the increased depreciation allowances are another indication of the improved financial position of companies throughout the chemical process industries.

► **Fast Amortization Slowed**—One of the notable features of depreciation entries in the 1955 financial reports is the tapering off of the sharp rise in amortization charges under the five-year emergency certificates initially granted during the Korean War. Between 1953 and 1954 these charges soared 29%. But between 1954 and 1955 depreciation charges increased only 15%.

In fact nearly all of last year's increase in depreciation and depletion charges—\$307 million of \$351 million—came under regular tax provisions.

► **Mergers Had a Hand**—The financial reports of some of the companies reflect mergers and acquisition of important new properties. Monsanto's 1955 report, which shows a 53% sales increase and a 78% leap in post-tax profits, is not comparable with that of 1954 because of a merger with Lion Oil. Hooker Electrochemical

adjusted its figures to include recently acquired Durez Plastics & Chemicals and Niagara Alkali. Rayonier's sales got a boost from the merger with Alaska Pine & Cellulose.

► **No Slump in Sight for '56**—Chemical Process Companies are optimistic about sales and profits this year. Some firms—like Norwich Pharmacal—expect higher earnings from new products. Others expect continued increases in earnings as new facilities get into volume production.

But basically, the hopes for another record year rest on sustained activity in the economy as a whole.

And present expectations for business generally are good. There will probably be a smaller auto output during the first part of the year, with early introduction of 1957 models perhaps bringing a sharp pickup in the fall. Housing starts will probably be slightly below 1955's near-record total of 1.33 million. However, strong markets for capital goods and normal growth in most consumer lines should keep industrial production from dipping much in 1956.

Industry can expect steeper wage rates this spring and summer. Built-in automatic increases in auto, electrical machinery and other industries already assure widespread wage boosts. Bargaining in the steel industry this spring is sure to result in increases for more industrial workers. Rising productivity and occasional price increases, though, may be enough to prevent an adverse effect on earnings.

► **Don't Sneeze at Normal Growth**—1955 was an exceptional year for the chemical process industries, as it was for the whole economy. The speedy recovery of business from the mild and brief recession that began in 1953 brought eye-popping increases in sales and profits last year.

But business was already moving too fast at the end of the year to permit another such burst in 1956. So the prospects this year are, in general, for normal growth. And that's not bad, by any measure.

CPI's Financial Strength*

Working Capital is up (million dollars)

	1954	1955
Chemicals.....	\$5,045	\$5,598
Paper.....	2,000	2,203
Petroleum.....	5,461	5,553
Rubber.....	1,473	1,664
Ceramic.....	1,724	1,875

Inventories are steady (million dollars)

	1954	1955
Chemicals.....	\$2,938	\$3,042
Paper.....	1,094	1,149
Petroleum.....	2,806	2,793
Rubber.....	966	1,106
Ceramic.....	889	890

* Three-quarter figures

Now—the Plant You Dream about...

Maintenance-Free because of Aluminum

Here's Why:

Aluminum resists rust and corrosion due to chemicals, gases, plant atmospheres, and coastal environments. You save the expense of painting and enjoy the natural bright appearance of this long-lasting metal. You save on replacement of parts destroyed by corrosion.

Build with Aluminum Throughout

Aluminum Structurals give you strengths equal to structural steel with only $\frac{1}{3}$ the weight. Ideal for framework and supports.

Aluminum Jacketing provides maintenance-free beauty plus the benefits obtained from natural insulation.

Aluminum Tread Plate is strong and light-weight, will not spark, resists rust and corrosion.

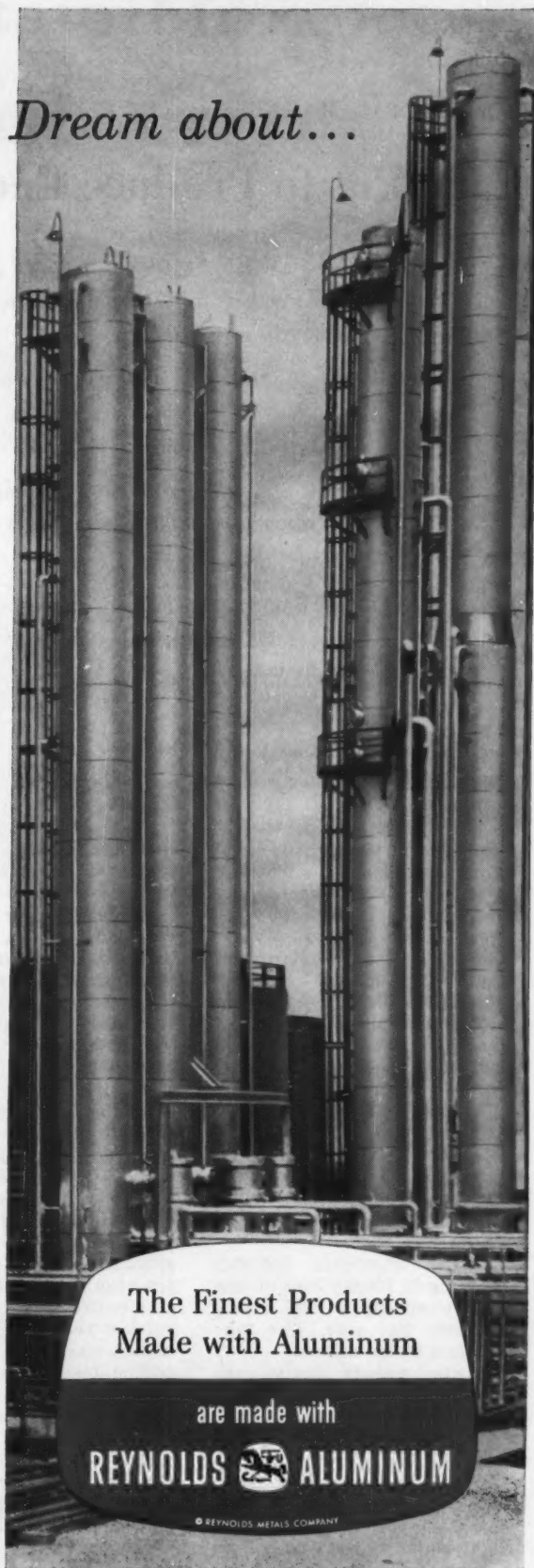
Aluminum Heat Exchanger Tubing offers lower initial cost, provides lower service costs.

Aluminum Accessories for gratings, railings, ladders and walkways.

Aluminum Process Pipe will not contaminate refined liquids and gases.

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Made with Aluminum

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REYNOLDS  ALUMINUM

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MOST METAL MAKERS:

Hard Put to Produce Enough

- **ALUMINUM . . .** Faced with a water power pinch, Al makers turn to solid fuels to meet energy needs of expansion.
- **STEEL . . .** Steel men must pay for costly "ground-breaking" if they are to push past present capacity limits.
- **COPPER . . .** Producers need but can't use their whole capacity as world strikes squeeze supply, blow up price.
- **TITANIUM . . .** Uncle Sam keeps producers busy but Ti's high price makes for tough peddling to industry.

Cecil H. Chilton, Sr. Assoc. Editor

The outlook this year for most metal producers is cheerful enough. The unprecedented demand which spurred them to record earnings and production levels last year should carry most, if not all, of the way through 1956.

In fact, if the metal makers have a "problem" it's that of finding themselves in the not unpleasant situation of being hard pressed to fill urgent orders from government and industry for their products.

To implement their optimism and meet the challenging demand the producers are already committing plenty of new capital for capacity expansions and plant modernizations in the coming months.

• The aluminum industry will bring in 700,000 tons of new primary capacity in 1956, a 45% hike over last year. The tab: close to a billion dollars.

• Steel makers plan to push capacity up 15 million tons, to 143 million tons a year, by 1959. And they'll spend about \$3 billion to do it.

• Eleven more copper mines—some old, some new—were opened in the U.S. last year. Eight major new mines will be

under way throughout the world by 1960.

• Yearly titanium capacity will soar from 7-8,000 tons a year of sponge to more than 20,000 tons by the end of this year.

Whatever the rewards of this ambitious building they will be hard won in many instances. The steel industry, for example, faces problems in financing the costly new capacity. Aluminum smelting, with its high consumption of electric power, is hard put to find supplies of cheap power for future expansions. Strike-plagued copper producers hope they can fully utilize their capacity, both present and that which they're building.

► **Aluminum Still Tight**—During most of 1955, demand for aluminum outran available supply, even though that supply was at a record high. Domestic output last year totalled about 1.57 million tons, up from 1954's 1.46 million tons. Records will continue to be broken as the industry girds for a new all-time high this year.

One factor tightening the supply was a strong demand for aluminum in Europe. This siphoned off some Canadian metal which otherwise might have

moved south. It looks like more of the same in 1956.

Eventual relief is expected from the huge wave of capacity expansions now made or being planned. Oldtimers Alcoa, Kaiser, and Reynolds will be boosting their smelting capacities. One new producer, Anaconda, began operations during 1955, and others are getting set to enter the field.

This new capacity will yield a second benefit in that it will per se make aluminum supply less critical from a defense standpoint. Thus, it may be possible for the government to lower its stockpile requirements. Alcoa points out a significant trend: Recent increases in aluminum demand have been accounted solely by growing civilian applications, particularly in private housing and commercial construction.

► **What Price Kwh?**—Severe droughts affect some aluminum producers as much as they do the farmer. Shortages of hydroelectric power have curtailed aluminum production in the Pacific Northwest and in Quebec. Alcoa describes its capacity expansion at Wenatchee, Wash., as a "calculated risk" since power supply will be on an interruptible basis.

And there isn't much prospect of large new blocks of cheap hydro power becoming available in the U.S. One exception is the St. Lawrence Seaway development, which will permit Alcoa to expand production at Massena, N. Y., during 1958.

What with cheap natural gas getting harder to come by, too, future aluminum expansion will be based more and more on not-so-cheap power from solid fuels. This will have its compensations, though. It will permit an aluminum producer more freedom of choice in plant location, with a chance to make big savings in transportation costs.

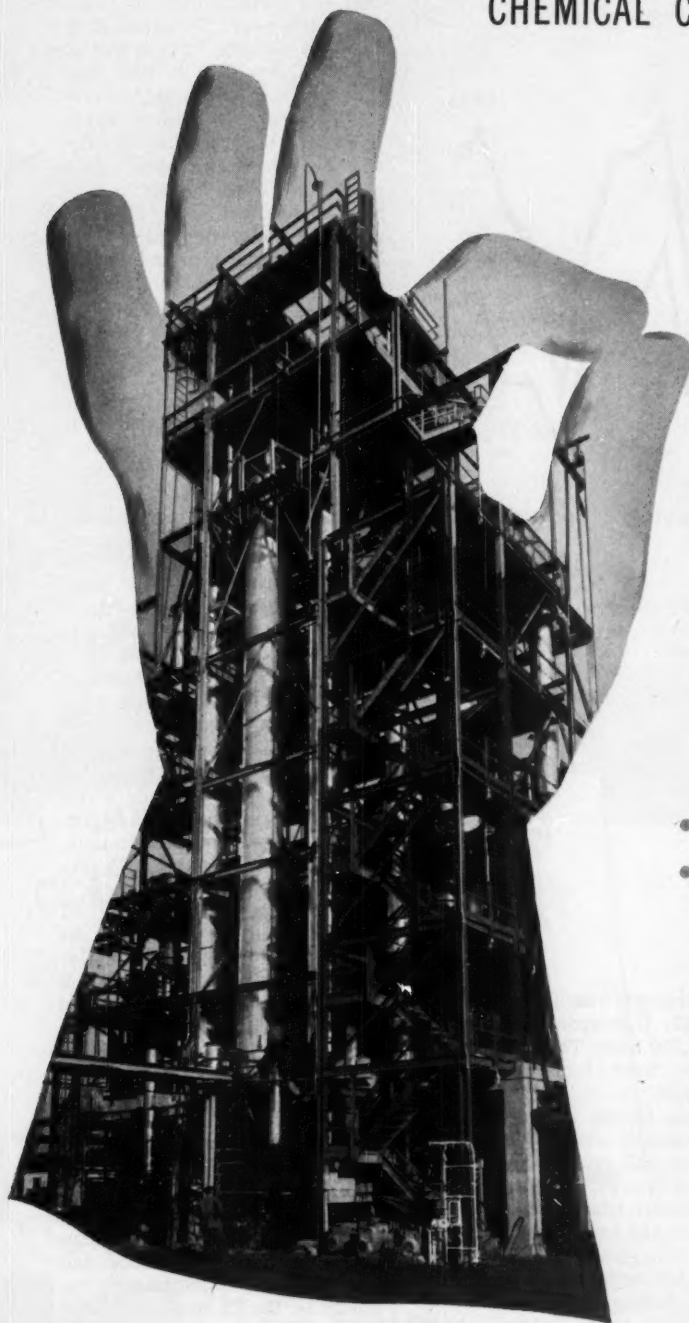
Illustrating this trend are the plans of four firms—established producers, Reynolds and Kaiser, and newcomers Olin Mathieson and St. Joseph Lead—to locate smelting plants in the upper Ohio valley. They will enjoy the advantages of nearby coal deposits and cheap river transportation of raw materials and products.

► **Steel Bumps Capacity**—U.S.

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production of steel last year was a record 117 million tons of ingots, exceeding even the rosiest predictions made early in the year. It was well above the previous high of 111.6 million tons chalked up in 1953.

Despite an anticipated drop in steel consumption this year by the automobile and construction industries, production is expected to match 1955's level. More steel going into machinery, home appliances, oil wells and pipelines will help shore up demand.

Rated U.S. steel capacity at the start of 1956 was 128.4 million tons vs. 125.8 million tons the year before. According to a Republic Steel forecast, minimum capacity requirement for 1955 will be 155 million tons.

► **Fiscal Dilemma**—The steel industry has been criticized at times for dragging its feet on capacity expansion.

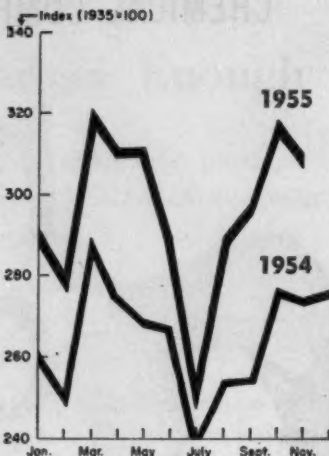
An important factor behind this hesitancy is the cost of new capacity. The original cost of facilities in place today was on the order of \$50 per annual ton of capacity. Even recent expansion of existing facilities have cost only about \$85 per ton. Now, however, the character of steel expansion is changing. It must of necessity be aimed at new areas, new mines, new fully integrated facilities. This makes expansion really expensive with an estimated \$325 required to provide an annual ton of steel capacity, from ore mine to finished mill product.

With steel shares quoted at a price equivalent to about \$70 per ton of industry capacity, it's clear that steelmakers can't raise capital on the open market. Hence, expansion has to be financed from retained earnings and private debt. Servicing the debt lowers net earnings, and retention of earnings in turn lowers the market value of shares. Raising prices is obviously necessary, but this again subjects the industry to public criticism.

No matter how they get the money, steel producers will have to spend \$1 billion per year between now and 1965 in order to keep ahead of demand.

► **Ti Set for Expanded Use**—An estimated 1,800 tons of titanium

Chemical Consumption



Consumption by Industries

	Nov. (Final)	Dec. (Est.)
Coal products.....	12.0	12.5
Explosives.....	9.6	9.2
Fertilizer.....	72.2	77.0
Glass.....	23.9	23.0
Iron & steel.....	18.8	19.3
Leather.....	4.0	4.3
Paint & varnish.....	28.6	24.4
Petroleum refining...	30.0	31.4
Plastics.....	24.7	25.5
Pulp & paper.....	36.4	34.4
Rayon.....	31.1	32.1
Rubber.....	7.6	7.0
Textiles.....	11.1	10.3
Total.....	310	310

mill products reached consumers in 1955. U.S. sponge production was 7,200 tons. The unconverted sponge went into government stockpile.

These figures represent a major advance over 1954's 1,300 tons of mill products and 5,370 tons of sponge.

Although titanium sponge production has been rolling merrily along, the amount of metal processed into mill products has been disappointing.

What's been holding back wider use of titanium, besides its \$8-13/lb. price tag? According to Rem-Cru Titanium, these have been the problems and some of the recent solutions:

• **Sponge and mill products** have been of nonuniform, uncertain quality. Quality improve-

ments during 1955 were significant and further progress is expected this year. (Titanium Metals Corp. reports, "There was so much improvement in 1955 that the subject lost interest.")

• There have been delays—unrelated to titanium—in airframe and engine production programs. These appear to have been worked out.

• Aircraft companies were loath to design titanium into production applications until they were sure of getting enough to meet their needs. Expansion of sponge capacity and stockpiling of sponge have removed doubts as to adequate supply.

With production orders for military aircraft already assuring a major increase in use of titanium mill products this year, the industry is now pushing the use of titanium in industrial applications. Mill output in 1956 is expected to be 3-4,000 tons.

► **Cu, Pb, Zn Picture**—Producers of copper, lead and zinc share in metals' optimistic outlook.

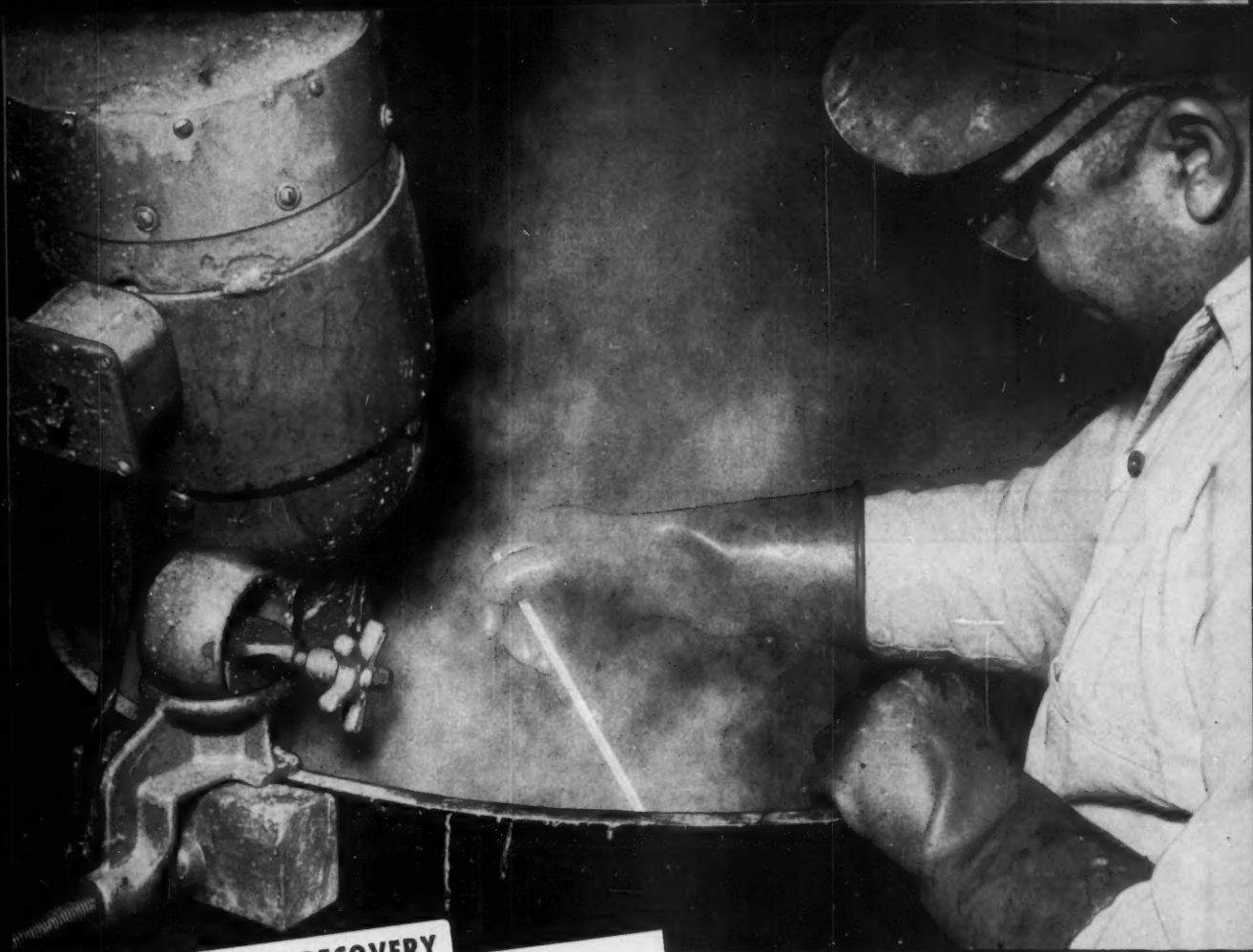
Total U.S. supply of copper in 1955 was 1.68 million tons. This was up encouragingly from 1954's 1.56 million tons despite serious strikes in Northern Rhodesia, the U.S. and Chile which disrupted operations.* U.S. copper supply will continue to gain, it's expected, to about 1.75 million tons in 1957.

Free-world consumption of lead and zinc in 1955 were the highest ever. Lead's two major markets—storage batteries and tetraethyl lead—are stable and growing. They depend not on the rate at which autos and trucks are made but on the total number of vehicles in current use. So a turndown in auto production won't hurt lead consumption.

Zinc's big outlet, galvanizing of steel, will grow with steel's growth. Steel makers are planning ten more continuous galvanizing lines to supplement capacity of the 26 lines now operating. (This is a big step since continuous equipment already represents 75% of galvanizing capacity.)

► **Frisky Prices**—All three metals, copper, lead and zinc, are

* Copper & Brass Research Assn. estimates strikes cost the free world 150,000 tons of copper in 1955.



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subject to wide variations in price. These can be due to relatively slight changes in the supply-demand ratios, since strong demand encourages operation of high-cost, marginal facilities.

For example, half the world's supply of copper can be produced

for less than 15¢/lb., and 90% for less than 25¢/lb. Yet so many high-cost producers are needed to meet today's demand that prices well over 35¢/lb. result in spite of competition from cheaper aluminum.

Producers of copper, lead and

zinc, seeking some degree of price stability, are urging consumers to take a long range look at their needs and not to get panicky if demand should temporarily exceed supply. For, overall, those supplies should be adequate for the next several years.

GUIDED TOUR CONTINUED



PICTURED FLOWSHEET

U. S. ore will yield chromium 308

NAMES IN THE NEWS

Man of the month: Raymond S. Stevens 315

Names that made news last month 316

PRO & CON

Letters to the editor 326

TECHNICAL BOOKSHELF

Newcomers for your reference shelves 333

Briefly noted 337

More new books 339

FIRMS IN THE NEWS

Who's doing what among your suppliers 341

TECHNICAL LITERATURE

Manufacturers' new literature . . . in Reader Service

COMING SOON

Liquid Proportioning May

Problems in Handling Liquefied Gases May

Inflation in Economic Analyses May

Comparison of Nitric Acid Processes May


Handling of Compressible Fluids June

Philosophy of Pilot Plant Design June

Where and How to Use the Drag Coefficient July


U. S. ore for chromium.

Now leaning on foreign ores American producers eye the day they'll throw that crutch away. Electro Metallurgical's new chemical process promises to supply our needs from low-grade home ore. (p. 308)




Your letters let us know!

Welcomed by the Editor, our readers' views sweep wide range of topics, add another dimension to our coverage. (p. 326)



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Inside Back Cover

There is every reason—and now is the season—to **TEST YOUR TOWER**

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Whatever your situation, it pays to test, and now is the time.
Write for your copy of "Test Your Tower" today!

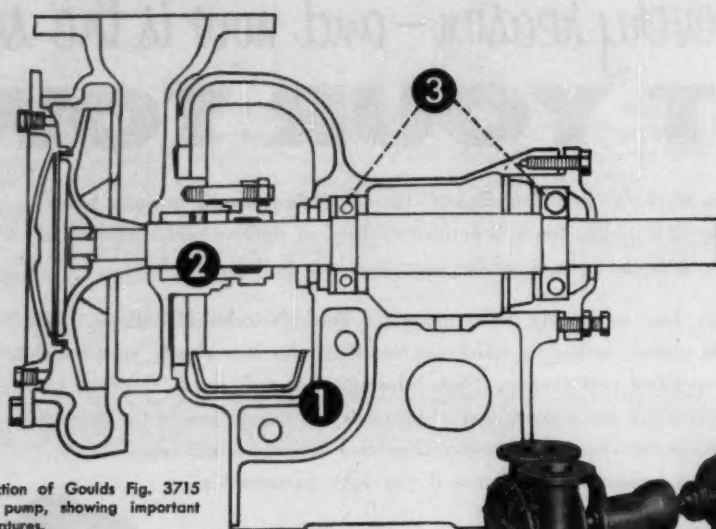
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Kansas City, Missouri





Cross section of Goulds Fig. 3715 chemical pump, showing important design features.

You can put the heat on this chemical pump

Handling hot, corrosive, or abrasive liquids is what the Goulds Fig. 3715 pump is built for.

You can run this pump at 350° F. by cooling the support head (1) and quenching the gland, through fittings that are built in.

And you can get the pump in a variety of materials to meet your particular liquid-handling needs—type 316 stainless steel, Gould-A-Loy 20 (equivalent to ACI CN 7M CU), all bronze, bronzefitted, all iron, or iron or bronze with stainless trim. These materials regularly stocked—other material can be furnished on order.

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There's a size, too, to meet most requirements—nine sizes in all, providing capacities up to 720 GPM, and heads to 200 ft.

Whatever size and construction material you need, you can be sure that your Goulds Fig. 3715 pump will operate with high efficiency and low maintenance cost.

Mechanical seals available

The stuffing box (2) is on the suction

side of the impeller, subject to suction pressure only. Or we can equip your pump with either a single or double mechanical seal. Completely sealed bearings (3) keep out dirt and moisture, and are grease lubricated.

You can inspect and clean the interior of the pump, or remove and replace the impeller, without disturbing piping connections. You can adjust axial clearance between the impeller vanes and the casing by external means.

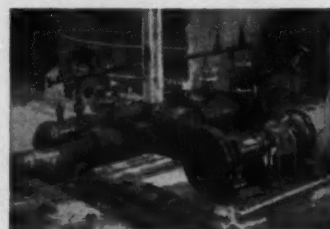
Interchangeability of parts

And you can keep your parts inventory low, for many of the parts are standardized for interchangeability between sizes. For example, you need only two different shafts for all 9 sizes of Fig. 3715 pumps.

We'd like to send you additional details about these chemical pumps. Just drop us a line, asking for Bulletin 725.4. It gives performance curves, sizes and specifications. Or, if you have a pumping problem of any kind one of our representatives will be glad to consult with you about it.



Goulds stainless steel pump handling corn meal mush in a food plant.



This Goulds chemical pump is handling hot fatty acids in an oil processing plant.



These three Goulds chemical pumps circulate hot size in a textile plant.



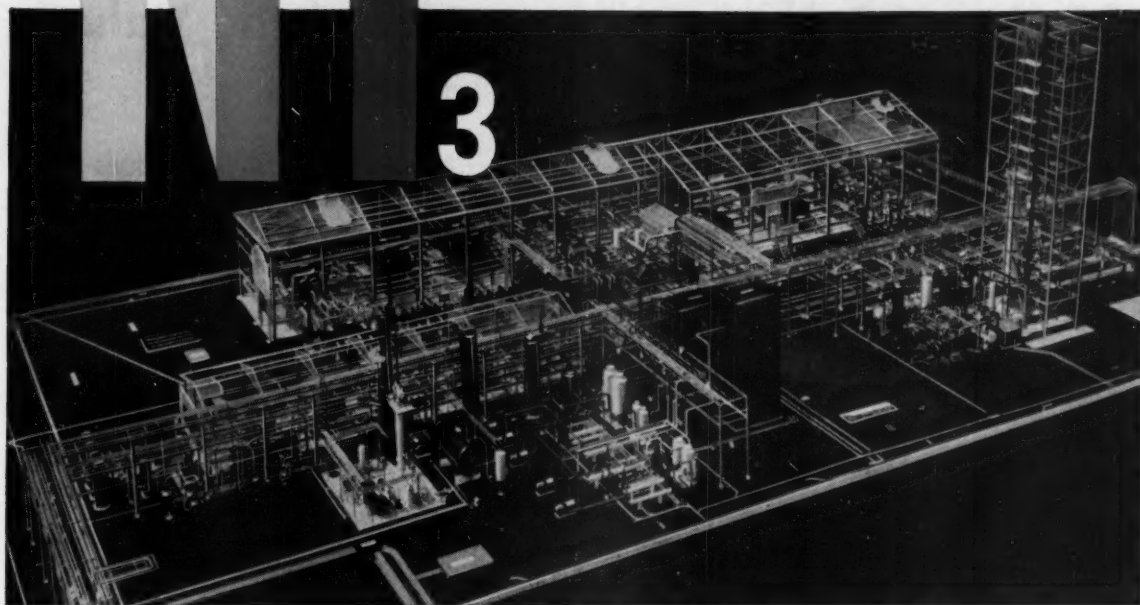
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CONDENSER TUBE CLINIC

Edited by Arthur W. Tracy,
Metallurgical Engineer,
The American Brass Company,
Waterbury, Connecticut

25 Years' Experience has proved the Value of Arsenic as an Inhibitor

Research at The American Brass Company nearly a quarter of a century ago showed that about 0.04% arsenic would inhibit dezincification of brass, and this amount of the element has been added to Admiralty metal and aluminum brass since then.

Inland power stations find that ANACONDA Arsenical Admiralty-439 serves well under normal water conditions, its arsenic content effectively inhibiting dezincification.

Tidewater power stations must contend with much more corrosive waters, and ANACONDA Ambraloy-927, the arsenical aluminum brass, is preferred because it is not only resistant to dezincification but also to impingement or erosion pitting by either clean or polluted sea waters flowing at relatively high velocities.

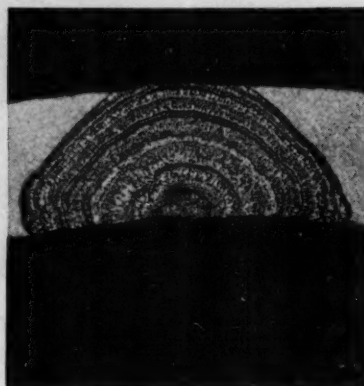
Oil refineries have virtually made ANACONDA Arsenical Admiralty-439 standard for refinery condensers and

TWO TYPES OF DEZINCIFICATION IN NONARSENICAL CONDENSER TUBES



(approx. 120X)

LAYER-TYPE DEZINCIFICATION on the inner wall of an uninhibited Admiralty metal tube from an oil refinery using polluted fresh water.



(approx. 17X)

PLUG-TYPE DEZINCIFICATION on the inner wall of an uninhibited Admiralty metal condenser tube from a power plant operating on tidewater.

heat exchangers handling crudes, re-run stocks, cracked products, lubricating oils, and by-products. It is resistant to dezincification and can handle corrosive cooling waters at relatively high temperatures. Another important property is its ability to withstand attack by sulfur compounds resulting from the refining of sour crudes. ANACONDA Ambraloy-927, because of its resistance to dezincification and to pitting corrosion by sea water at relatively high velocities, is sometimes preferred in oil refineries on tidewater.

Marine users generally find ANACONDA Arsenical Admiralty-439 satisfactory for inland-water vessels and also for seagoing vessels where service conditions are moderate; but ANACONDA Ambraloy-927 is preferred for most seagoing vessels. Both alloys are resistant

to dezincification under all corrosive conditions found in these services.

Your own needs may call for these corrosion-resistant Anaconda alloys or they may call for other tube alloys we make. Our Technical Department will be glad to help you select the one best alloy for the conditions you face.

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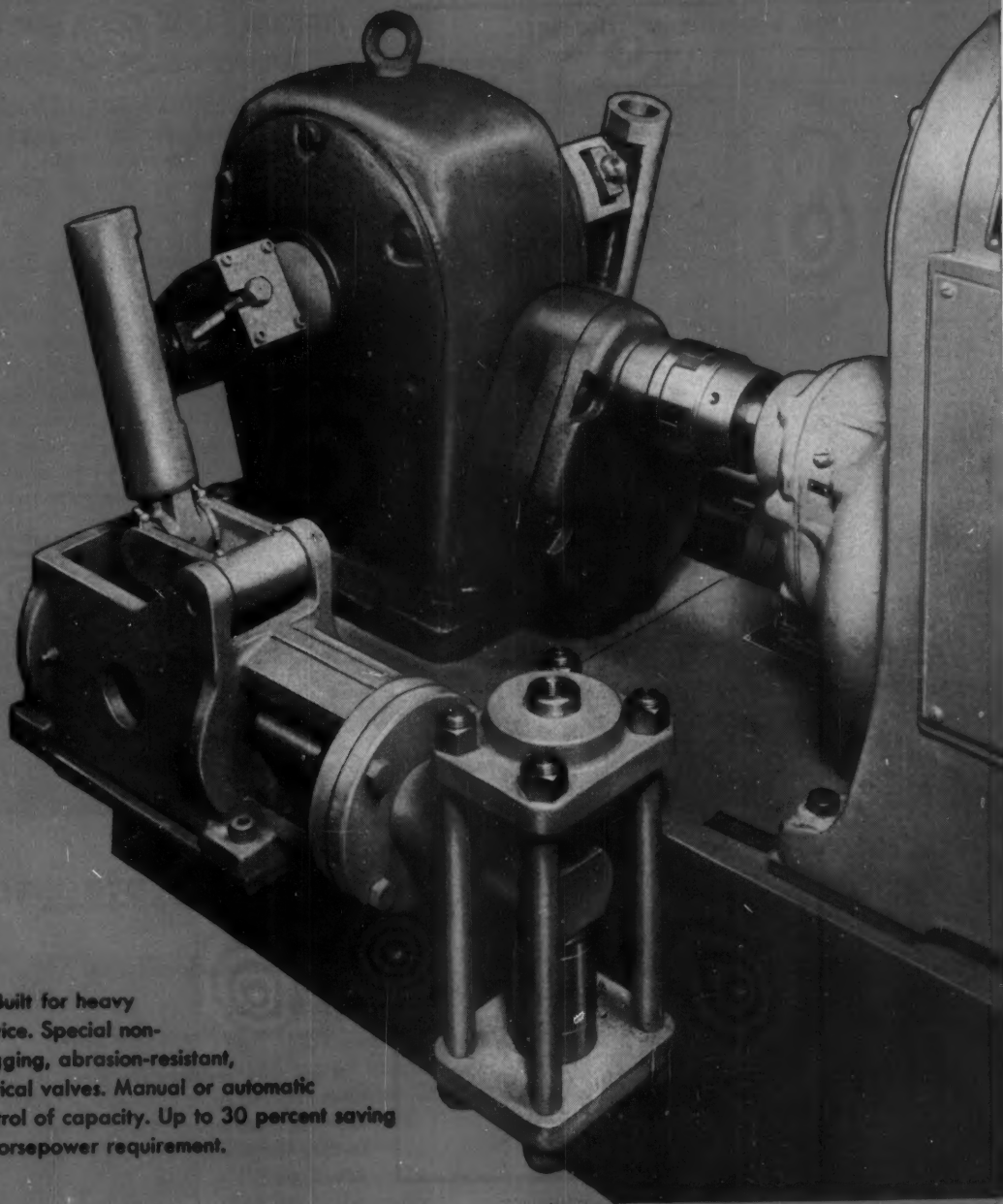
	Arsenical Admiralty-439	Ambraloy-927
Tensile Strength, psi.	52,000	60,000
Yield Strength, 0.5% Elongation, psi.	22,000	27,000
Elongation in 2", %	60	55
Rockwell Hardness "B"	6-45	35-65
Density, lb./cu. in.	0.308	0.301
Thermal Conductivity, B.T.U./Sq. Ft./In./Hr./°F. at 68°F.	768	696
Coefficient of Linear Expansion, Average per °F. (77°-572°F.)	0.0000112	0.0000108

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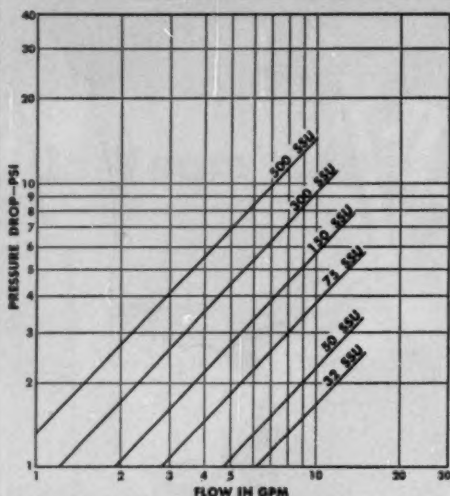
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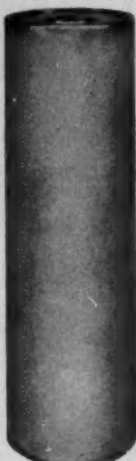
DESIGN AND APPLICATION NOTES ON

Cuno's new Poro-Klean Filter

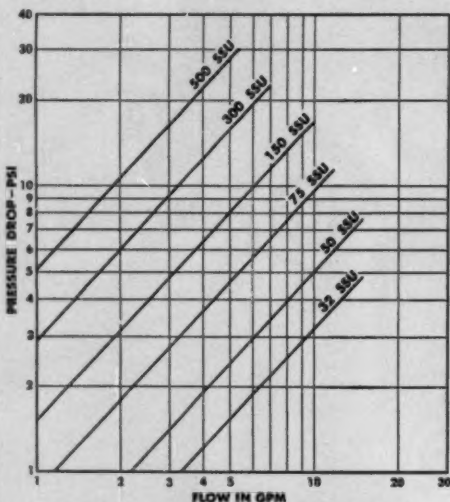
TYPICAL PORO-KLEAN FLOW DATA



FLOW DATA FOR TYPICAL CYLINDRICAL-TYPE, coarse-grade, PORO-KLEAN filter element, fluid viscosity as parameter. Filtration to 15 microns.



CYLINDRICAL TYPE



FLOW DATA FOR TYPICAL CELL-TYPE, medium-grade, PORO-KLEAN filter element, fluid viscosity as parameter. Filtration to 5 microns.



CELL TYPE

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Typical PORO-KLEAN applications, already in use in the chemical and process industries, are listed below. Approximate flow-rate curves for typical cell and cylindrical standard elements are shown at left (for exact data, see your Cuno representative).

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- Fixed-bed catalyst fines from petroleum products
- Over-cooked gels from polymers
- Radioactive contamination from light and heavy water
- Fine precoat particles downstream from primary filters
- Contamination and/or catalysts from high-temperature and high-pressure refinery gases
- Metal oxides from molten sodium, sodium-potassium, and bismuth
- Iron oxides from fuels
- Rust from steam
- Foreign matter from pharmaceuticals

TO RECOVER:

- Catalysts from gases and liquids

TO DISPERSE:

- Gases into liquids and other gases

If you have problems like these, let Cuno engineers help you apply PORO-KLEAN to their solution. See your Cuno representative, or write Cuno Engineering Corporation, 31-4 South Vine Street, Meriden, Conn.

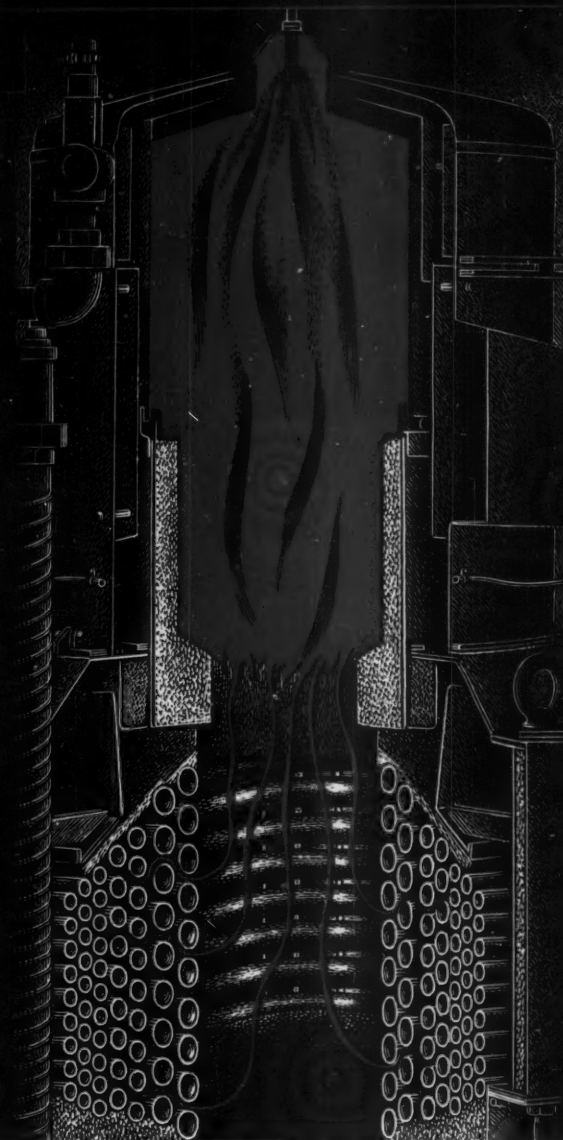
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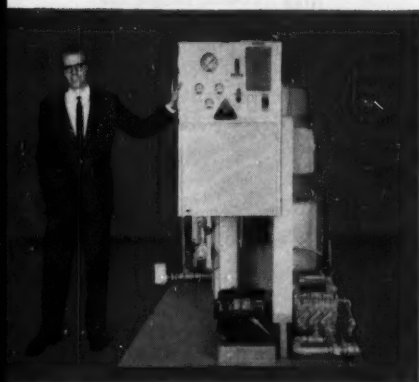
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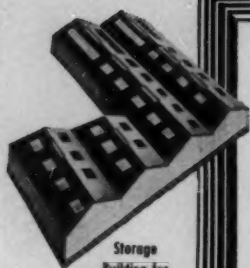
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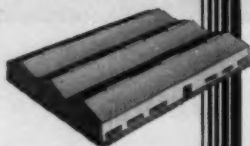
Storage Building for J. I. Case Co., Racine, Wisconsin



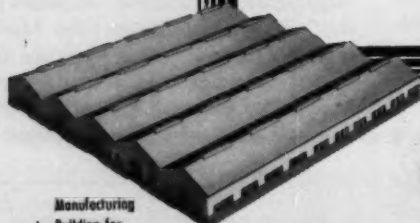
Warehouse and Loading Dock for J. I. Case Co., Bettendorf, Iowa



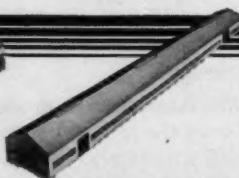
Manufacturing Building for J. I. Case Co., Anniston, Alabama



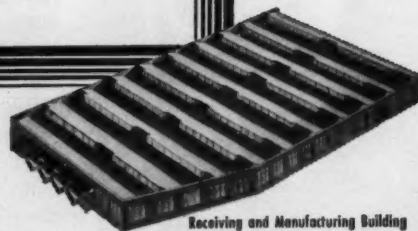
Branch Showrooms and Warehouse for J. I. Case Co., Houston, Texas



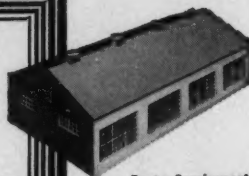
Manufacturing Building for J. I. Case Co., Stockton, California



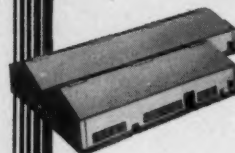
Storage Building for J. I. Case Co., Racine, Wisconsin



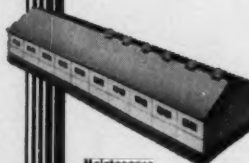
Receiving and Manufacturing Building for J. I. Case Co., Racine, Wisconsin



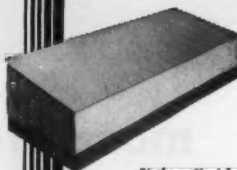
Tractor Development and Testing Building for J. I. Case Co., Racine, Wisconsin



Tool & Pattern Shop for J. I. Case Co., Anniston, Alabama

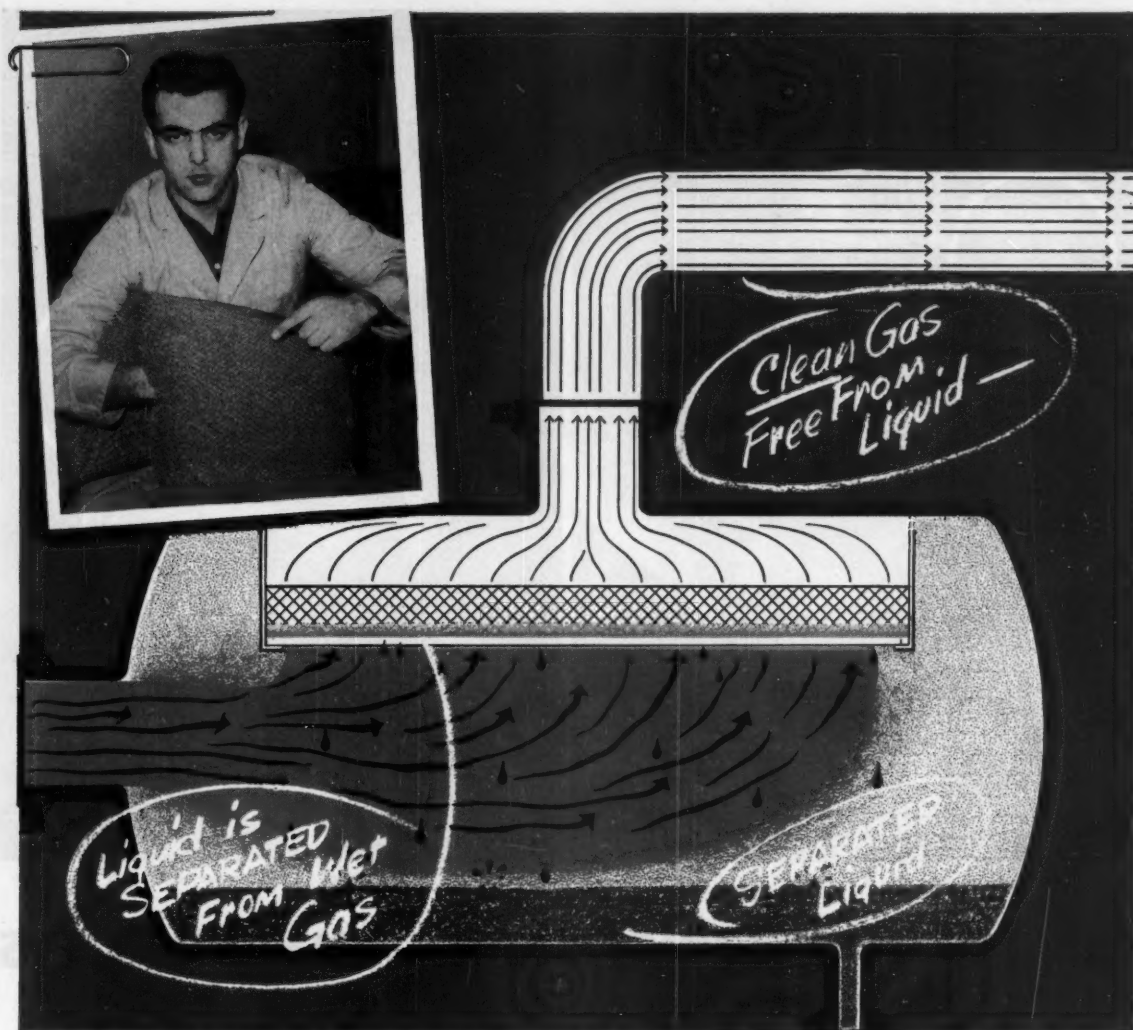


Maintenance Building for J. I. Case Co., Rockford, Illinois



Platform Shed for J. I. Case Co., Burlington, Iowa

LURIA Customers are REPEAT Customers



How to INSURE Good KNOCK-OUT Drum PERFORMANCE

The only positive way to insure good performance in Knock-Out drums is to provide a positive barrier to entrained liquid flow which at the same time is practically non-restricting to gas flow.

This dual requirement is inherent in YORKMESH DEMISTERS where the high percentage of voids permits unobstructed gas flow and the extensive surface area effectively separates out the entrained liquid.

The practical result is high separation efficiency at low pressure drop.

For existing or new equipment why not send operating data, and let York Engineers take the responsibility for improved performance.

We will recommend and select the best style Demister from the many available, which includes the hi-thruput Herringbone style.

Similar improvements in process efficiency are effected by the clean separation of vapor from liquid in:

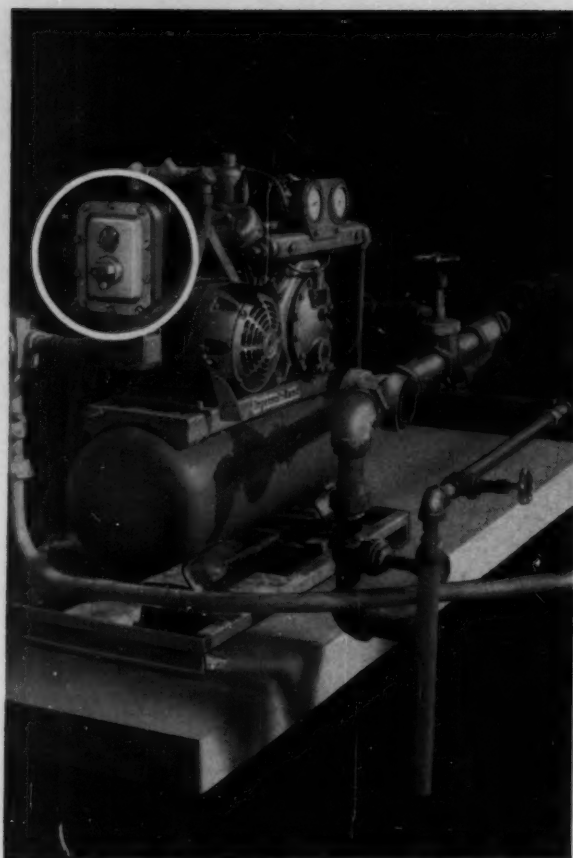
**Vacuum Towers • Flash Tanks
Distillation Equipment • Evaporators
Absorbers • Scrubbers • Steam Drums**

Write for Bulletin 17 and a complete list of the many case histories available from our technical library.

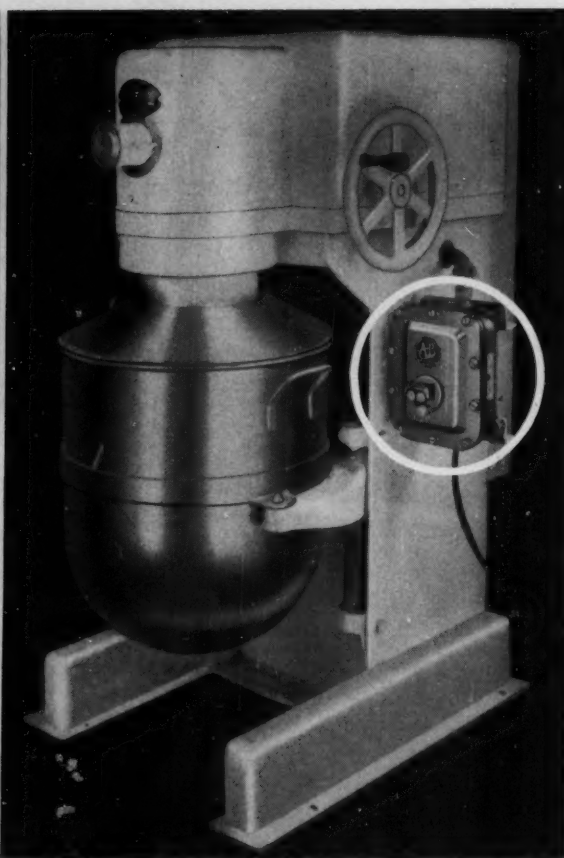
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OTTO H. YORK COMPANY, INC.
6 Central Avenue, West Orange, N. J.

Specialists in FLUIDS SEPARATION / ENGINEERS and MANUFACTURERS



Allen-Bradley explosion-proof starter on LPG Ingersoll-Rand compressor



Allen-Bradley explosion-proof solenoid starter on Triumph paint mixer

CUT YOUR ELECTRICAL MAINTENANCE COSTS

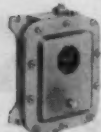
by choosing the correct enclosure for every job



Type 1
General
Purpose



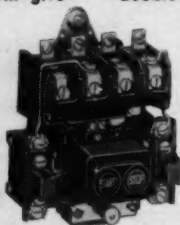
Type 4
Watertight



Type 7
Explosion-
proof

When you order a motor starter, be sure to specify the type of enclosure that will give adequate protection to the starter and operator under the conditions that exist where it is used.

In the Allen-Bradley line is a variety of standard enclosures that satisfy any operating requirement. They assure long, trouble-free service and thereby cut "down time" due to unnecessary inspection or also motor starter failures.



Bulletin 709 Size 1
Solenoid Starter

Since all Allen-Bradley motor starters use double break, silver alloy contacts which require no maintenance, bolted enclosures are no problem for the serviceman. Actually, you can install an Allen-Bradley starter and forget it. There is only ONE MOVING PART ... the solenoid plunger. There are no linkages, bearings, pins, or pivots to rust and stick. Such simplicity is your guarantee of dependability.

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Hazardous
Corrosive Gas



Type 9
Hazardous
Dust



Type 11
Corrosion-
proof

Allen-Bradley Co.
1337 S. First St.
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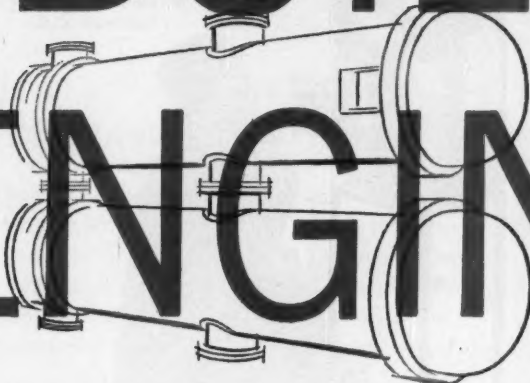
ALLEN-BRADLEY
SOLENOID MOTOR CONTROL

QUALITY

In Canada—
Allen-Bradley Canada Ltd.
Galt, Ont.

For Optimum Efficiency at Minimum Cost,
Heat Transfer Equipment Needs Kellogg's

BUILT-IN ENGINEER



WHEN a process plant's efficiency, and even its economic success, depends on the performance of heat exchangers, this vital equipment becomes more than a "packaged" item or even a matter of following specifications. Optimum performance, at minimum cost to the customer, demands all of the extra know-how, know-when, and know-where that the fabricator can put into the job. It requires, for example, a thorough knowledge of heat transfer, stress analysis, metal fatigue, corrosion control, metallurgy, and welding techniques, plus the inherent ability to apply this knowledge to the specific problem at hand.

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cation of this kind of knowledge—which goes into the design and fabrication of every Kellogg heat exchanger or other processing unit, is what we call the "built-in engineer". This important extra, together with Kellogg's other facilities guarantees performance, minimizes maintenance, and often reduces initial costs. In one recent instance, a saving of \$5,000 for a customer resulted from a slight change in design suggested by Kellogg's staff.

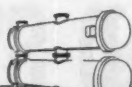
We welcome the opportunity to demonstrate, in cooperation with your own design engineers or alone, what Kellogg's "built-in engineer" can contribute to your new process equipment.

Fabricated Products Division

THE M. W. KELLOGG COMPANY, 225 BROADWAY, NEW YORK 7, N. Y.

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HEAT TRANSFER
EQUIPMENT



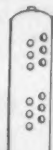
PROCESS
PIPING



KNOCKDOWN
VESSELS



TANKS AND
REACTORS



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VESSELS

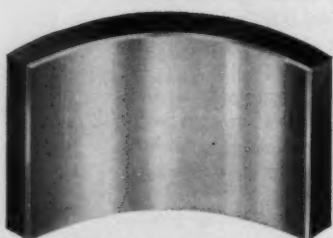
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long equipment life
as solid high alloy!**

**... at savings up to
50% in material costs!**



Clad steel demonstration unit recently featured at the Nat'l Assoc. of Corrosion Engineers show.

LOOK AT THE RECORD!



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In tanks, pressure vessels and other vital equipment, clad steel can be found wherever corrosion, abrasion or product contamination are problems. Why? Because economical clad steel delivers the benefits of solid high alloy ... at savings in material costs up to 50%!

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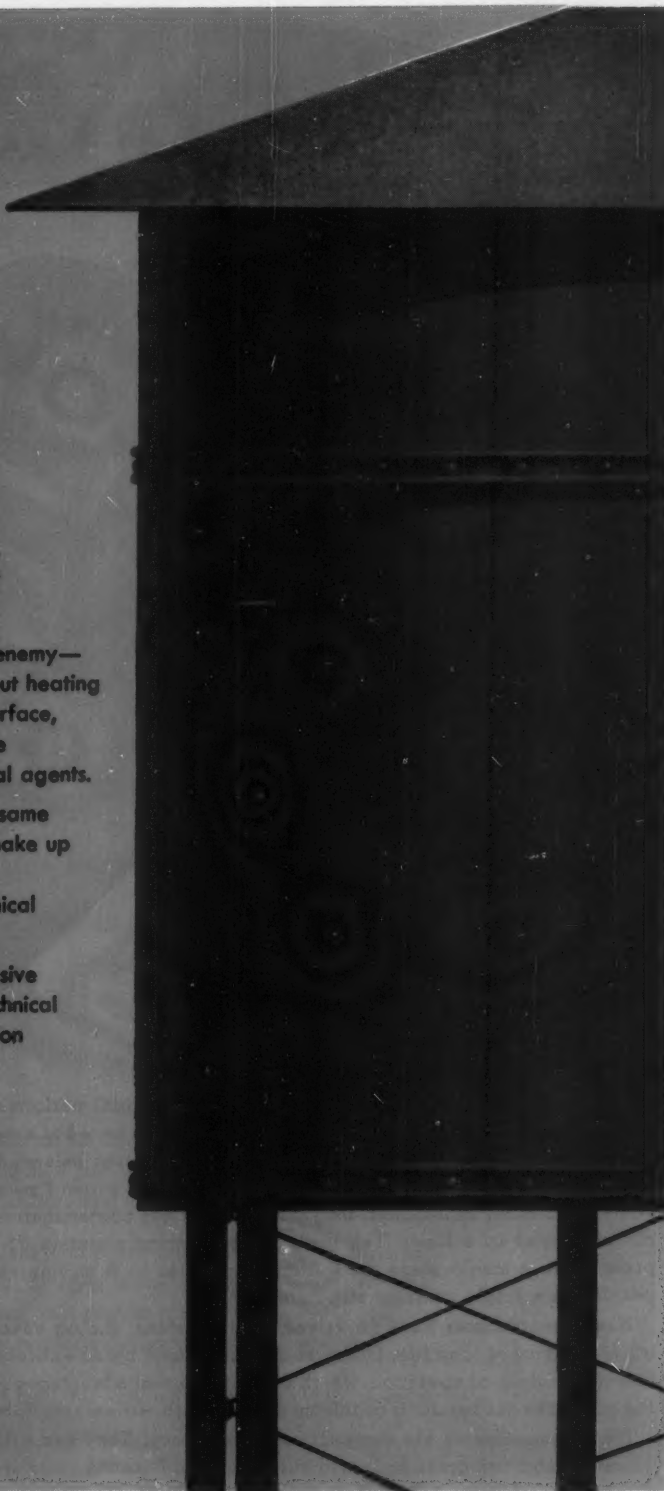
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Barrett protective Cold Coatings are industry's answer to its ever-present enemy—corrosion. They can be applied without heating by brush or spray to any exposed surface, metal, masonry or wood, and provide protection against destructive chemical agents.

These coatings are derived from the same high quality coal-tar materials that make up famous Barrett Pipeline Coatings. Yet they are among the most economical protective coatings on the market.

For full information on Barrett's extensive line of industrial coatings, and for technical assistance with your particular corrosion problem, write or call Barrett today.



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The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintain 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

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Saves floor space.
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75 pounds in a single stage.

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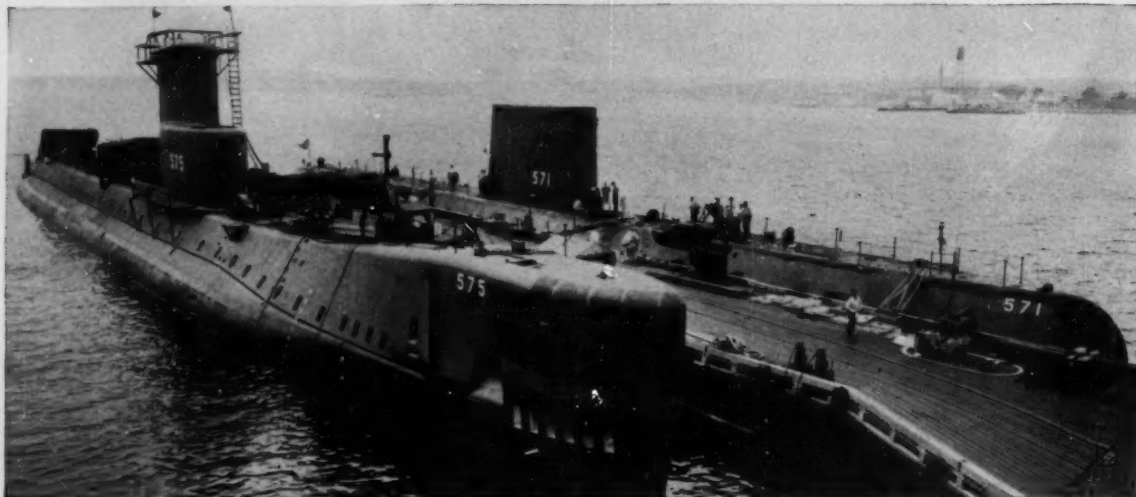
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Unibestos insulates vital pipe systems

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Aboard these ships, where dependability is a must, Unibestos pipe insulation protects intricate and vital pipeline systems against crucial heat loss. Unibestos makes a clean sweep in its contribution to this important Navy development program.

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Unibestos® pipe insulation is available in sectional form through 44" O.D. For further information without obligation, write for the free descriptive bulletin 109C.



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The Mark of

Better Filtration

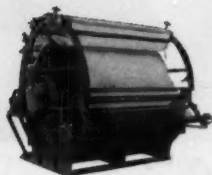
Tear a small piece from the continuous sheet of cake coming from a FEinc String Filter. Turn it over in your hand. In the closely spaced grooves you'll see why FEinc gives better filtration . . . on jobs ranging from thick fibrous cakes to thin sticky slimes.

The strings literally lift the cake out of the weave of the cloth. No scraper to wear, smear or plug the fabric. The cake is dryer, too. Cleaner cloth aids filtrate removal, with less vacuum. No "blow-back" is needed to loosen the cake, hence no filtrate is blown back into the cake. If FEinc's Compression

Dewatering Mechanism is added, you get 2 to 6% more moisture out of the cake.

It all adds up to higher yield with FEinc: Cleaner, more workable cake . . . higher recovery of solubles . . . higher filtration rates with a smaller filter . . . extra savings in reduced "down-time" and longer cloth life.

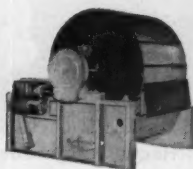
The Original String Discharge Filter is now only one of many types of FEinc continuous rotary vacuum filters available . . . custom-made at standard costs. Write for bulletins today, or ask for performance studies. No obligation, of course.



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HORIZONTAL



SCRAPER

CUSTOM DESIGNED CONTINUOUS FILTRATION

FEinc

*For a
Bigger Yield*

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Jacketing forms around pipe easily. A two man crew can apply jacketing without special installation equipment. Aluminum strapping and seals make application simple and quick, reducing labor costs. Factory-attached moisture barrier is

recommended where the presence of moisture could harm aluminum from the under side. The resin type adhesive used exclusively by Childers to bond moisture barrier to under side of jacketing withstands temperatures up to 300°F.

1,286 Plants in 48 States and 14 Foreign Countries

Insure Insulation Efficiency with Childers Jacketing

Leading engineers world-wide specify Childers Jacketing for protecting costly insulation on lines, towers, vessels and tanks. These efficiency minded engineers prefer Childers Jacketing because of these exclusive features:

1. LAP-SEAL (patents pending) insures a more positive weather-seal.
2. Heavy weight jacketing designed for lines subject to abuse.
3. Deep Corrugated Jacketing with factory-attached moisture barrier for towers, vessels and tanks.

4. New resin adhesive that makes a stronger bond between the jacketing and the vapor barrier.

Childers Aluminum Jacketing provides strong, durable protection with three way savings:

1. Lower first cost than any other permanent jacketing.
2. Lower application cost because it's so easy to cut-to-size and attach.
3. Eliminates maintenance because it is made of durable aluminum for maximum corrosion resistance and requires no painting.

Economy minded engineers know that plant efficiency is improved when costly insulation is protected with Childers Aluminum Jacketing. And too, the gleaming beauty of Childers Jacketing makes plants brighter, neater — reduces "housekeeping" costs.

Send for Free Sample and Prices

You can help increase the efficiency of your insulated lines, towers, vessels and tanks by using Childers Jacketing. Write today for free sample and engineering data. Childers Manufacturing Co., Dept. CE-14, Houston 8, Texas.



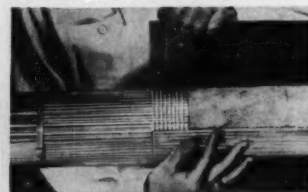
New Deep Corrugated Jacketing For Towers, Vessels and Tanks

Only Childers offers deep corrugated aluminum jacketing with factory-attached moisture barrier. Available in 1¼" and 2½" corrugations. Childers Deep Corrugated Jacketing is used to provide permanent protection for insulated towers, vessels and tanks.



Heavy Weight Jacketing

Only Childers offers .019" Jacketing in labor saving 4' wide rolls. This exclusive product is recommended to protect insulated lines along walkways and in other areas where they are subject to abuse; also recommended for protection of all insulated towers, vessels and tanks.



Lap-Seal

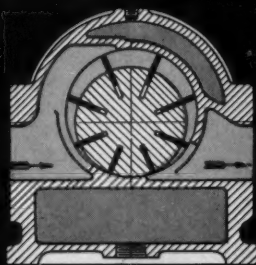
Childers exclusive LAP-SEAL is a series of eight ribs rolled into the underlapping edge of the jacketing.

Lap-Seal has 2 important advantages:

1. Where desired, a positive weather seal is easily made with Lap-Seal and a mastic.
2. Lap-Seal provides an automatic measure of the 2" circumferential lap. It saves labor, insures proper lap and prevents waste.

ALLIS-CHALMERS

Rotary COMPRESSORS



HOW RO-FLO UNITS OPERATE

Centrifugal force moves blades to outside wall to form air chamber.

You get MORE ADVANTAGES

with **RO-FLO** units for shop air,
drilling, gas handling

TYPE and SIZE for EVERY NEED

Both single and two-stage *Ro-Flo* compressors are available. Single-stage units for pressures to 50 pounds gauge, and volumes from 42 to 3245 cfm.

Two-stage units in twelve sizes for 250 to 1800 cfm at pressures from 60 to 125 pounds gauge.

Single and two-stage *Ro-Flo* vacuum pumps for vacuums to 0.3 inch mercury absolute, from 22 to 5950 cfm.

Call your nearest A-C office or write for bulletins 16B8244 (two stage) and 16B8126 (single stage). Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

- 1 CONSTANT EFFICIENCY** — During operation the sliding vanes of the rotor press against the cylinder wall to form air cells. Even if these vanes wear, the rotating force holds them in contact with the cylinder wall so that efficiency and air flow never change.
- 2 LOW-COST FOUNDATIONS** — Smooth rotation cuts vibration. This eliminates need for heavy foundations used with reciprocating-type units. Small units can be bolted directly to the floor. Large units need only a simple slab.
- 3 COMPACTNESS** — No extra weight or extra size is needed to dampen vibration. Every inch is devoted to air or gas handling.
- 4 LOW MAINTENANCE** — There is no wear and tear from shock and vibration... no pistons and valves.

Ro-Flo is an Allis-Chalmers trademark.

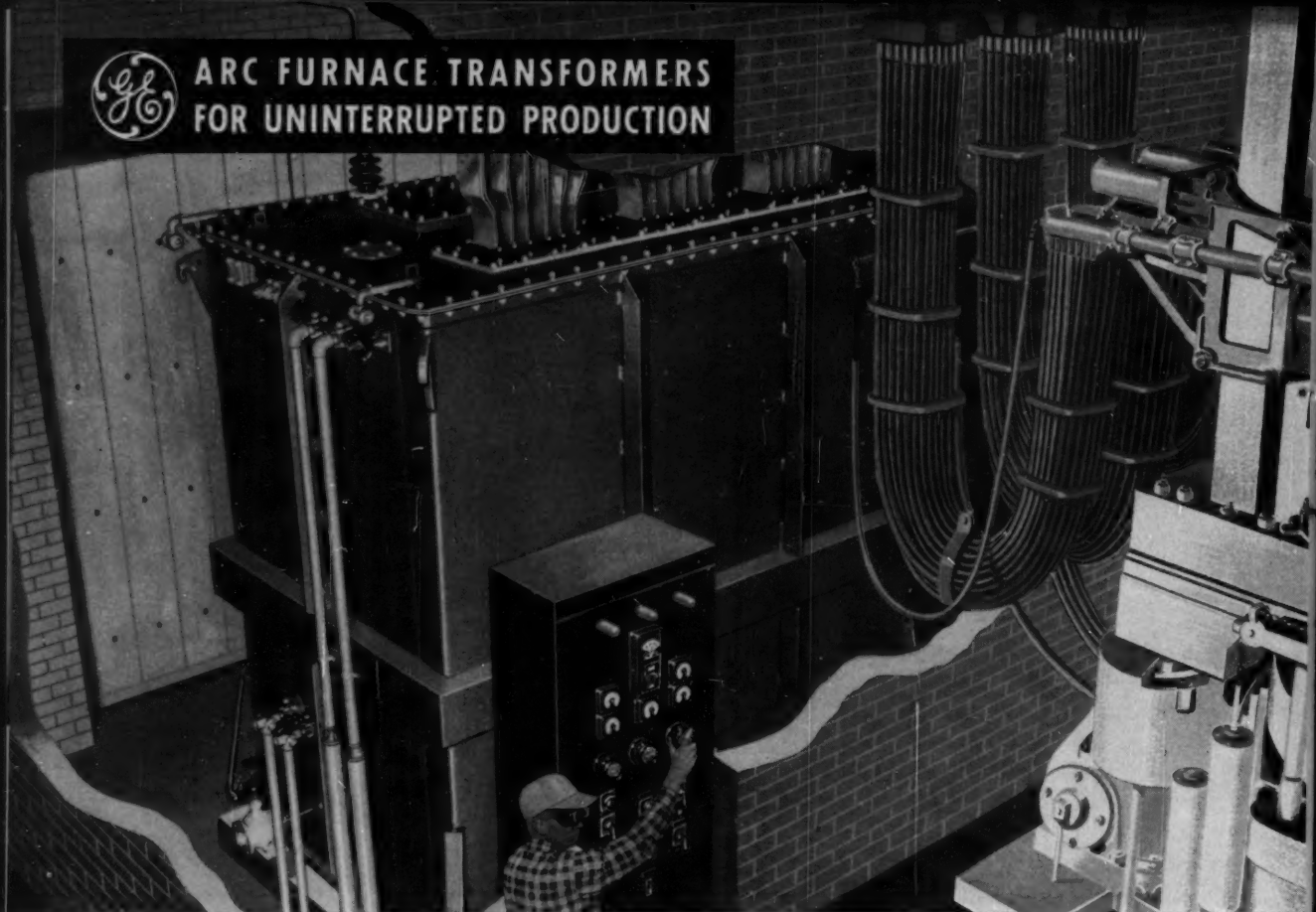


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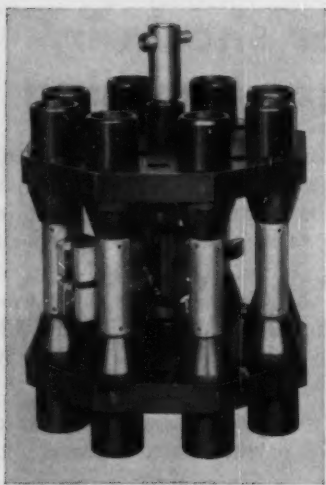


ARC FURNACE TRANSFORMERS FOR UNINTERRUPTED PRODUCTION



YOU CAN COUNT ON PRODUCTION CONTINUITY WHEN YOU INSTALL A GENERAL ELECTRIC ARC FURNACE TRANSFORMER.

Not one G-E tap-changer contact failure since wedge-type introduction in 1938



HEART OF TAP-CHANGER mechanism is the circular arrangement of contacts. Made of specially tin-plated copper, they have high current-carrying ability with low contact temperature, and a wedging action which assures good contact under all operating conditions.

Since the introduction 18 years ago of the General Electric wedge-type tap changer, no contacts have ever separated, carbonized, welded, or otherwise failed according to our records. This is another example of the outstanding record of reliability established by G-E arc-furnace transformers.

The tap changer itself is designed with liberal electrical, mechanical, and thermal safety factors. It can, in fact, withstand the full short-circuit current of the transformer without injury. Furthermore, a special safety interlock between tap-changer driving mechanism and primary circuit breaker prevents any chance of tap-changer operation under load. Because of the tap

changer's reliability, it can be strategically located in the main tank close to the windings, thus permitting great savings in floor area.

Tap changers are only one of many features which make G-E arc furnace transformers your best bet for long-term reliability. Others include core-type construction with inherently strong circular-concentric windings, dust-tight bus-bar seal, and high-pressure-tested cooling systems.

For complete details contact your nearest G-E apparatus Sales Office or write for Bulletin GEA-6236 to General Electric Company, Section 422-27, Schenectady 5, New York.

Progress Is Our Most Important Product

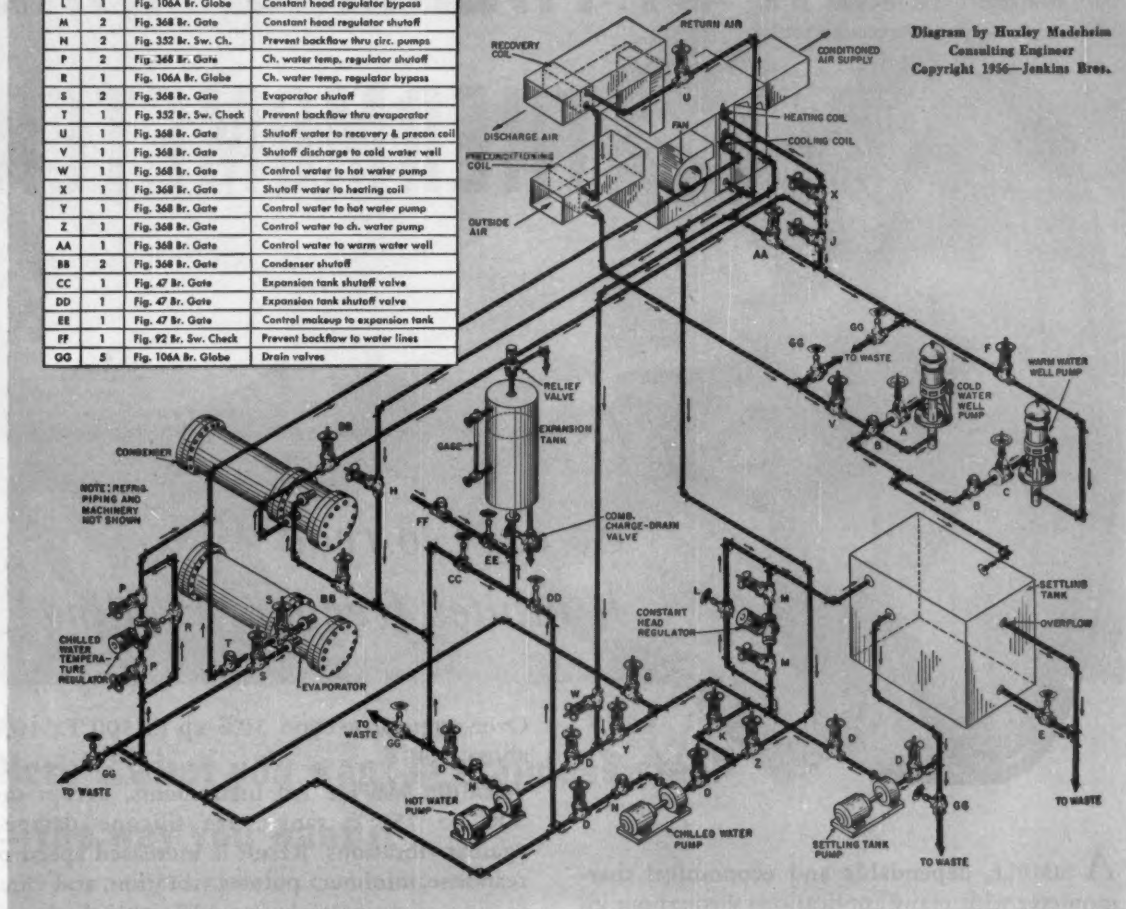
GENERAL  ELECTRIC

JENKINS PRACTICAL PIPING LAYOUTS

77

Diagram by Huxley Madeheim
Consulting Engineer
Copyright 1956—Jenkins Bros.

Code	Quan.	Jenkins Valve	Service
A	1	Fig. 677A Br. Gate	Cold water well shutoff valve
B	2	Fig. 293 Br. Sw. Check	Prevent backflow thru well pumps
C	1	Fig. 677A Br. Gate	Warm water well shutoff valve
D	6	Fig. 368 Br. Gate	Circ. pump shutoff valves
E	1	Fig. 106A Br. Globe	Settling Tank drain valve
F	1	Fig. 368 Br. Gate	Shutoff discharge to warm water well
G	1	Fig. 368 Br. Gate	Control water to evaporator
H	1	Fig. 368 Br. Gate	Control water to condenser
J	1	Fig. 368 Br. Gate	Control water to warm water well
K	1	Fig. 368 Br. Gate	Control water to ch. water pump
L	1	Fig. 106A Br. Globe	Constant head regulator bypass
M	2	Fig. 368 Br. Gate	Constant head regulator shutoff
N	2	Fig. 352 Br. Sw. Ch.	Prevent backflow thru circ. pumps
P	2	Fig. 368 Br. Gate	Ch. water temp. regulator shutoff
R	1	Fig. 106A Br. Globe	Ch. water temp. regulator bypass
S	2	Fig. 368 Br. Gate	Evaporator shutoff
T	1	Fig. 352 Br. Sw. Check	Prevent backflow thru evaporator
U	1	Fig. 368 Br. Gate	Shutoff water to recovery & precon coil
V	1	Fig. 368 Br. Gate	Shutoff discharge to cold water well
W	1	Fig. 368 Br. Gate	Control water to hot water pump
X	1	Fig. 368 Br. Gate	Shutoff water to heating coil
Y	1	Fig. 368 Br. Gate	Control water to hot water pump
Z	1	Fig. 368 Br. Gate	Control water to ch. water pump
AA	1	Fig. 368 Br. Gate	Control water to warm water well
BB	2	Fig. 368 Br. Gate	Condenser shutoff
CC	1	Fig. 47 Br. Gate	Expansion tank shutoff valve
DD	1	Fig. 47 Br. Gate	Expansion tank shutoff valve
EE	1	Fig. 47 Br. Gate	Control makeup to expansion tank
FF	1	Fig. Y2 Br. Sw. Check	Prevent backflow to water lines
GG	5	Fig. 106A Br. Globe	Drain valves



How to plan piping connections for all-year

AIR CONDITIONING WITH THE HEAT PUMP

Well water is used in the basic heat pump installation illustrated. Such a system could readily serve a building with several exterior and interior zones, which would have many air handling units. For simplicity, only one unit is shown in the diagram.

For heating demands, this system provides a closed circuit consisting of hot water pump, condenser, and heating coil. For cooling, a second closed circuit consists of chilled water pump, evaporator, and cooling coil.

During the heating season, water is supplied to the settling tank from the warm water well (about 60° F). It is circulated

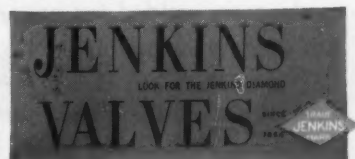
by the chilled water pump to the evaporator, and then to the cooling coil to provide cooling, where needed, for interior areas. The water then flows to the recovery coil, picks up heat from waste air and carries it to preconditioning coil, where it is used to preheat outside air. The resulting chilled water is discharged to the cold water well.

During the intermediate seasons, water is supplied to the settling tank from the cold water well (about 50° F). It is circulated by the hot water pump to the condenser, and then to the heating coil to provide heat, where needed, for the exterior zones. The water is then discharged to the hot water well.

During the cooling season, water from the cold water well is pumped to the settling tank, and then circulated to the evaporator and the cooling coils. It is next used to cool the condenser, and is then discharged to the hot water well. If the demand for cooling is low, and the well water cold enough, the evaporator may be bypassed.

Consultation with accredited piping engineers and contractors is recommended when planning major piping installations.

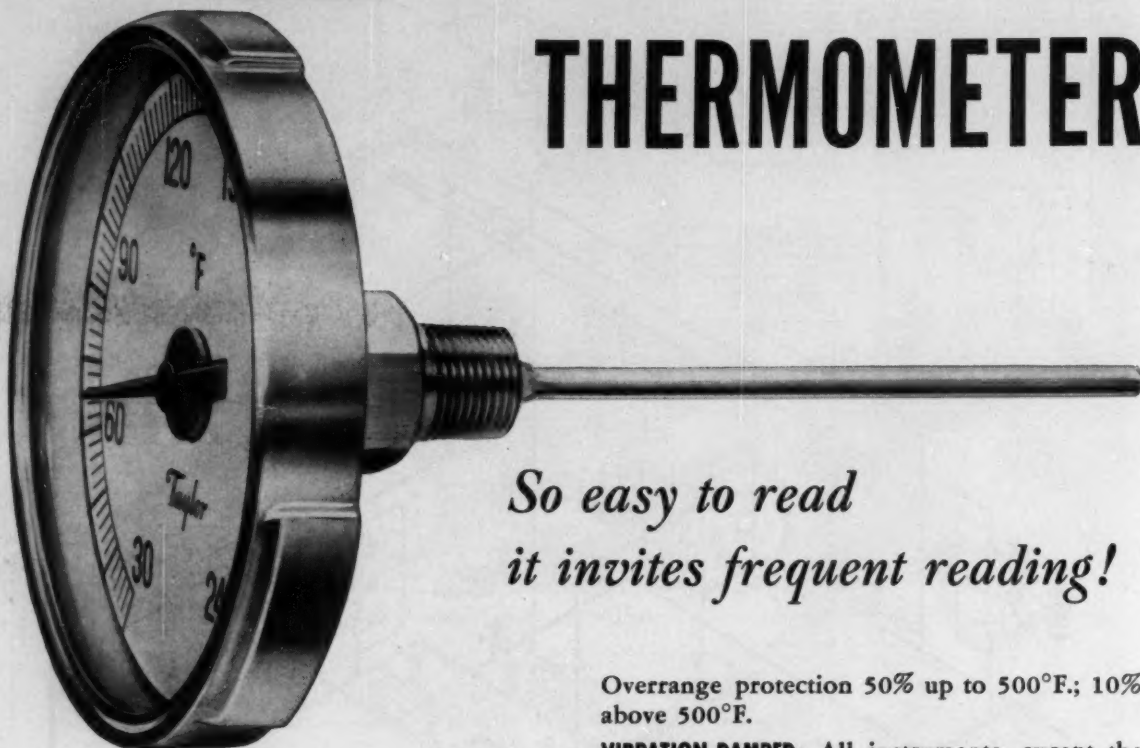
Enlarged diagram and full description of this layout free on request. Ask for Layout No. 77. Jenkins Bros., 100 Park Ave., New York 17.



SOLD THROUGH PLUMBING-HEATING AND INDUSTRIAL DISTRIBUTORS

Traditional Taylor accuracy in a low cost instrument

THE NEW BI-THERM* 5" DIAL THERMOMETER



*So easy to read
it invites frequent reading!*

A SIMPLE, dependable and economical thermometer with many applications throughout industry. Wide variety of ranges from minus 40° to +750°F. Also available with three inch dial; stem lengths of 4, 6, 9, and 12 inches; separable wells of brass, steel, type 304 stainless steel or monel.

EASY TO READ: The large dials are highly readable because of black figures and graduations on an aluminum background.

RUGGED: All exposed metal parts are of arc welded, corrosion-resistant stainless steel. All instruments are waterproof. All mechanical connections are welded for greater reliability.

ACCURATE: These instruments are accurate within $\pm 1\%$ of range, over the entire range. Simple zero-setting features correct minor errors in readings which might result from severe mechanical shock. No ambient temperature effect.

Overrange protection 50% up to 500°F.; 10% above 500°F.

VIBRATION DAMPED: All instruments, except the 200° to 750°F. range, are silicone damped against vibrations. Result is increased speed of response, minimum pointer vibration, and elimination of pointer chatter when the thermometer is handled.

ECONOMICAL: Costs only \$16 to \$26, depending on dial size and length of stem. Ask your Taylor Field Engineer, or write for **Bulletin 98267**. Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

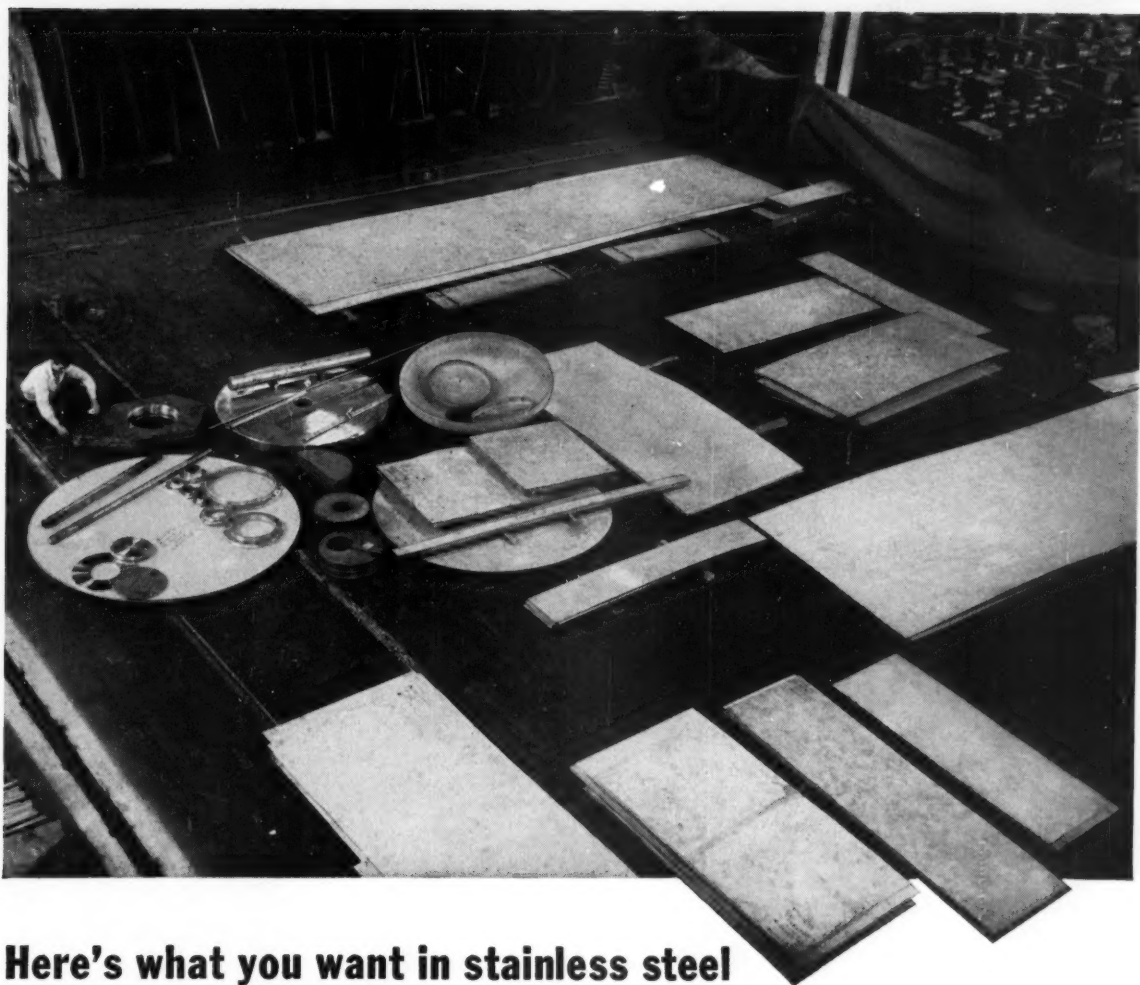
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Taylor Instruments

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IN HOME AND INDUSTRY



Here's what you want in stainless steel —the way you want it

Stainless Steel Plate . . . produced to almost any size or thickness, $\frac{3}{16}$ " and heavier, in rectangles or cut-to-shape. Carlson maintains what is probably the largest stock of stainless plate in the country—produced to highest chemical and metallurgical standards—ready for cutting to your requirements, and for shipment when you want it.

Stainless Steel Heads . . . spun or press formed to your order or taken directly from our stock of ASME and Standard flanged and dished heads—the *largest stock* maintained anywhere. In addition to supplying heads for tanks, heat exchangers, condensers and similar equipment, Carlson can fill a complete bill

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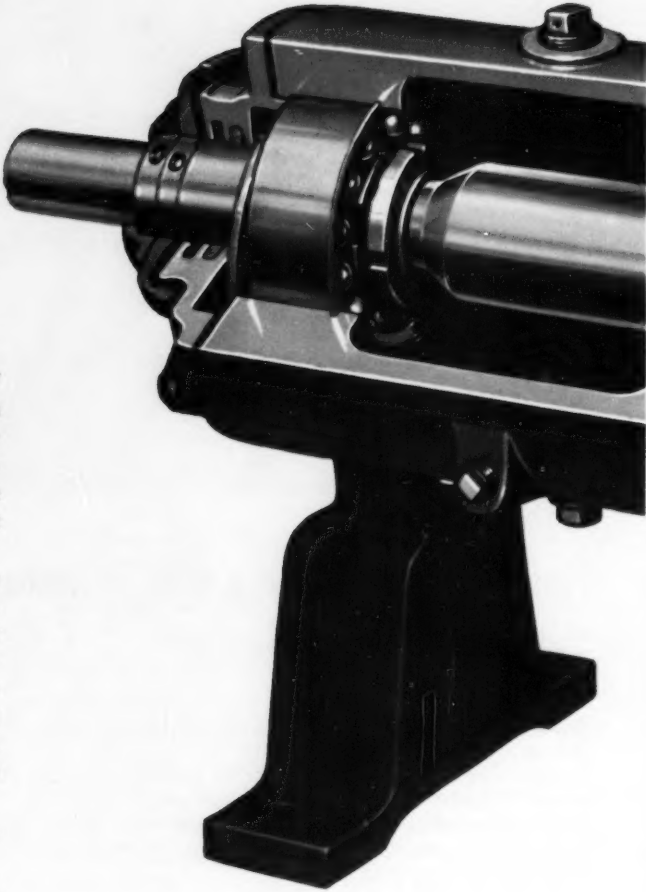
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The Series H Durcopump fulfills the need of the chemical industry for a heavy duty process pump to handle high heads at most capacity ranges at normal or elevated temperatures. Available in the complete range of Durco machinable alloys, it is the modern answer to your difficult corrosive pumping problems.

The Series H Durcopump is basically of simple design and rugged construction, with great versatility. It is intended to handle the toughest pumping conditions, as well as to meet your special requirements. It provides maximum service life, requires small spare parts inventory, and minimum down time for parts replacement. Durcopumps are available with capacities to 2000 GPM, and heads to 345 ft.

Available in the following standard DURCO machinable alloys:

Durimet 20, Chlorimet 2, Chlorimet 3, Durco D-10, Durco 18-8-SMo, Durco 18-8S, Monel, Nickel, Inconel, Ni-Resist #2, Cast Iron, Carbon Steel, and other special alloys.

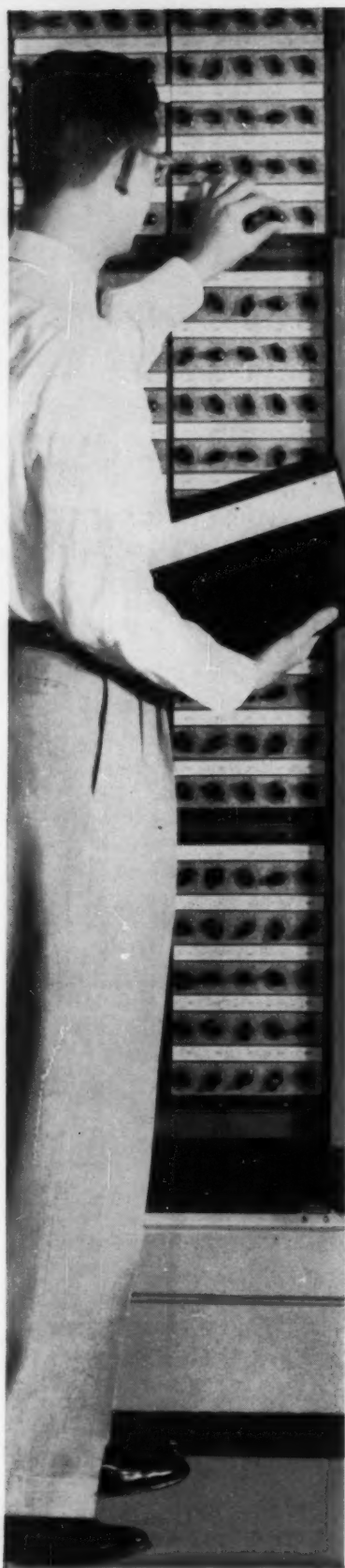
THE DURIRON COMPANY, Inc.
Dayton, Ohio

BRANCH OFFICES: Atlanta, Boston, Buffalo, Chicago, Cleveland, Detroit, Houston, Knoxville, Los Angeles, New York, Philadelphia, Pittsburgh



The All New Series H DURCOPUMP





Panalog Information Systems guide management in raising plant output and profit

Panalog 605 Information System supplies management control information. Now, operating personnel and management can receive organized digital information on any process, instantly and continuously. Information can be presented in a variety of forms for immediate control action as well as for engineering and accounting analysis. A typical presentation method employs an electric typewriter and patented log chart. Readout can also be made on punched or magnetic tape, or can be fed directly to computers.

Periodically logs and continuously scans. A precision servo measuring system quantizes process variables during automatic, periodic logging. A high-speed electronic measuring system detects off-normal conditions during continuous scanning of all variables. Normal and return-to-normal values are printed in black—off-normals in red. A complete log of all variables as well as a summary of off-normals can be made at any time.

Completely flexible and expandable. Panalog components are standardized, packaged modules. The system can be easily expanded or modified in the field. The Panalog 605 is sufficiently flexible to supply digital information for any management requirement.

Write for literature. Literature presenting a comprehensive treatment of the Panalog 605 is available. If you wish, a Panellit representative in your area will be happy to discuss the possibilities that a Panalog Information System offers your company.

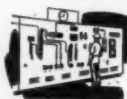
Full scale, adjustable, high and low off-normal limits are provided for each input variable. Basic system capacity, 200 points with one electric typewriter — can be expanded. Accuracy, $\pm 25\%$ of full scale range. Logging speed, approximately one line per minute. Scanning speed, five points per second, between logs.

Logged values are grouped by processing unit on chart. Audio-visual alarms accompany detection of off-normals. When scanning, off-normal values are identified and printed in separate chart area. Totalized and averaged values as well as plant efficiencies can be automatically computed and recorded by the system.



U.S. Pat. No. 2,701,748

Engineered Information Systems For Industry



Graphic Panels
Control Centers



Panalarm
Annunciators



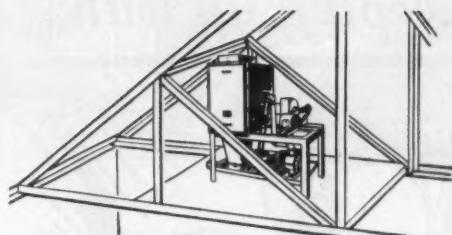
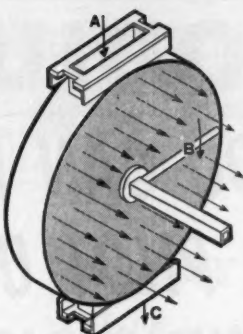
Instrument
Services Division



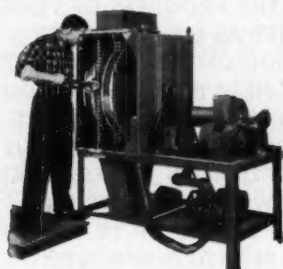
PANELLIT, INC.

7413 N. Hamlin Ave., Skokie, Ill.
Panellit of Canada Ltd., Toronto 14

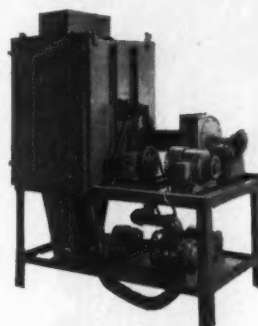
1 Air and dust enter filter drum through top (A). Air passes out through filter disc (shaded) leaving dust on inside. Jet arm (B) rotates around disc blowing reverse-air jet back through filter, dislodging dust. Dust falls out bottom of drum (C) into hopper.



2 Models from 520 to 4800 CFM capacities. Hang from rafters, place in corner, on platform—easily installed anywhere. Factory assembled—comes in "package."



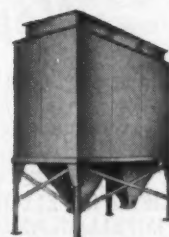
3 Automatic pressure control* maintains ideal filter-surface conditions by cleaning filter discs only when they need it and not over-cleaning them. Continuous high-efficiency is assured, filters last longer.



4 High-efficiency felt filtering material cleans more than 6 times as much air per sq. foot as ordinary woven cloth filters. Synthetic felts used for special applications. See how you can save time, money, space in your own operation with a Model D Aeroturn.

EXCLUSIVE! Continuous automatic operation with New Koppers Model D Aeroturn Dust Collector . . .

over 99.9% continuous efficiency! The "heart" of this new Koppers Model D Aeroturn (see illus. 1) is the *reverse-air-jet action*. This reverse air cleans the filter discs, *maintains* ideal filtering conditions *automatically*! Pressure controls action by switching air jet arm "on" when pressure rises . . . "off" when pressure is normal for highest efficiency.* When "on" the air jet arm rotates around bag radially—blowing an even-pressure air blast into the felt filter disc—agitating and dislodging dust accumulation, making it drop off inner wall into the hopper. No excess wear to "high-efficiency" felt disc—no unnecessary use of air jet mechanism—no stopping to clean filter. This completely automatic "package" dust collector solves your filtering problems with over 99.9% *maintained* efficiency.



New Series 12 Aeroturn for bigger dust filtering jobs, material reclamation. Standard sizes from 1,000 to 60,000 CFM—special units designed for greater capacities. Up to 99.9%+, a high "clean-air" efficiency.



Koppers Company, Inc.
Metal Products Division
Industrial Gas Cleaning Dept.
Engineered Products
Sold with Service

AEROTURN DUST COLLECTORS

Mail this coupon today!

KOPPERS COMPANY, INC., Industrial Gas Cleaning Dept., 5004 Scott Street, Baltimore 3, Maryland.

Gentlemen: Please send me a free copy of your Aeroturn Booklet with description, drawings and photographs. ☐ Model D ☐ Series 12

Name..... Title.....

Company.....

Address.....

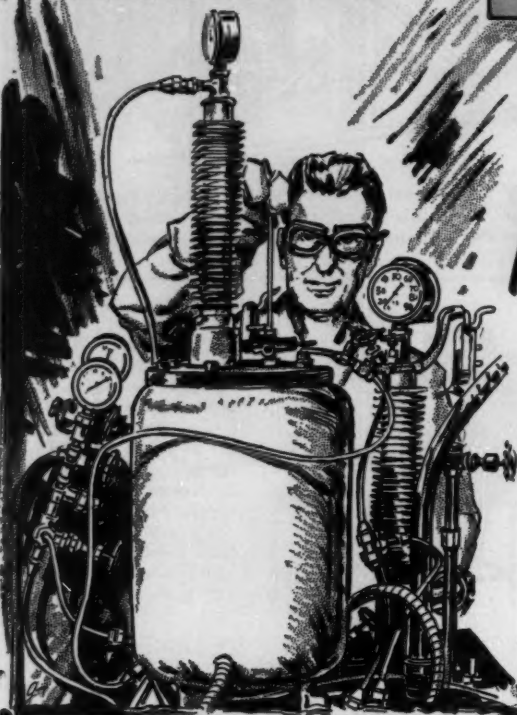
City..... Zone..... State.....

*Hersey Patents

keeping up with

SODIUM

YOU CAN BORROW A PILOT UNIT FOR MAKING DISPERSIONS



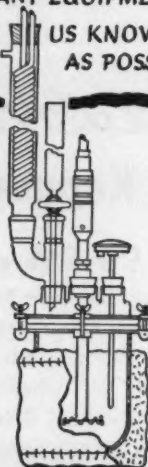
NEED HELP IN SPEEDING THE PROGRESS OF YOUR SODIUM PROJECTS? JUST AS U.S.I. HELPS BY PROVIDING SAMPLES OF SODIUM DISPERSIONS FOR RESEARCH, IT CAN NOW HELP BY LOANING YOU A PILOT SIZE DISPERSION UNIT FOR YOUR NEXT STEP. THIS UNIT WILL PREPARE 3 TO 4 GALLONS OF 10 TO 20 MICRON DISPERSIONS IN LESS THAN 20 MINUTES. RESULTS WILL DUPLICATE LAB EXPERIENCE AND CAN BE SCALED UP TO PERMIT PROPER DESIGN OF PLANT EQUIPMENT.

NO OBLIGATION, BUT LET US KNOW YOUR NEEDS AS FAR IN ADVANCE

AS POSSIBLE.

Prefab Dispersion Units Now Being Sold—

IF YOU WANT MILLILITERS FOR LAB EXPERIMENTS OR GALLONS FOR PILOT EVALUATION, COWLES DISSOLVER COMPANY WILL SELL YOU A PACKAGE UNIT. THESE UNITS WERE DESIGNED JOINTLY BY COWLES AND U.S.I. AFTER U.S.I. RESEARCH DEPARTMENT EVALUATED THE COWLES "DISSOLVER" AND FOUND IT AN EFFICIENT IMPELLOR FOR DISPERSING SODIUM. A DRIVE ASSEMBLY, IMPELLOR AND OTHER INDIVIDUAL PARTS ARE ALSO AVAILABLE FOR MODIFYING EXISTING EQUIPMENT.



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- **LIQUID-METALS HANDBOOK, SODIUM-NAK SUPPLEMENT**—JULY, 1955 BY A.E.C. AND DEPT. OF NAVY. (AVAIL. FROM SUPT. OF DOC., \$2.00.)
- **SODIUM PLUMBING**—A REVIEW OF UNCLASSIFIED RESEARCH AND TECHNOLOGY FROM OAK RIDGE NATIONAL LABORATORIES. (USAEC ORNL-1688, AVAIL. FROM TECH. SERV., DEPT. OF COMMERCE, \$6.00.)



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99 Park Avenue, New York 16, N. Y.
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CORPORATION BRIEFS



3,500 FATHERS

More than 3,500 users, specifiers and buyers have had a hand in the design of the Cooper Alloy stainless steel valve. We're proud of the fact that many of the design features it embodies owe their origin to your suggestions, and we are equally proud to learn that our valve clinics have helped to reduce maintenance costs.

These valve clinics have been held in most major industrial centers and on-the-spot in dozens of leading industrial plants. Completely technical in nature they are designed to assist in the selection, installation and maintenance of stainless steel valves.

Arrangements for a valve clinic in your own plant, similar to those already held at DuPont, Pfizer, Celanese, Dow, Mathieson and many others may be made through our public relations division.

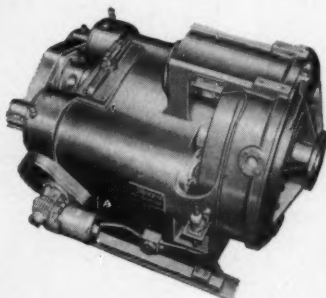
A note on your letterhead will start the wheels turning.

WHAT'S IN A TRADEMARK?

Behind the Cooper Alloy trademark, cast or stamped into our stainless steel fittings, stands more than a quarter century of experience and the most complete production facilities in the industry. When you specify Cooper Alloy fittings you can be sure that every step from design to shipment is under the supervision of specialists. Look for the CA trademark before you buy . . . it is a sign of quality, experience and reliability.



DOUBLE-D REFINER

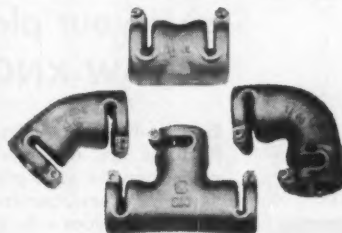


The Jones Double-D Refiner is said to bring an entirely new concept to the preparation of stock for the paper machine. Key to the design lies in the twin refining area with its double discs (stainless castings by Cooper Alloy, of course). For a more complete story ask for the February issue of Cooper Alloy NEWSCAST.

VANTON TO MARKET QUIKUPL®

Cooper Alloy patented Quikupl® stainless steel fittings are to be sold and serviced by Vanton Pump & Equipment Corp. and their network of representatives in all major industrial cities.

Quikupl fittings permit economical installation of pipe or tubing without welding, threading or flaring. They can be assembled or disassembled in a matter of seconds. Neoprene, butyl and thiokol seals are now in stock, with research underway to provide other materials offering greater corrosion and higher temperature resistance.



COOPER ALLOY
CORPORATION • HILLSIDE, N.J.

Divisions:



FOUNDRY PRODUCTS DIVISION



VALVE & FITTING DIVISION



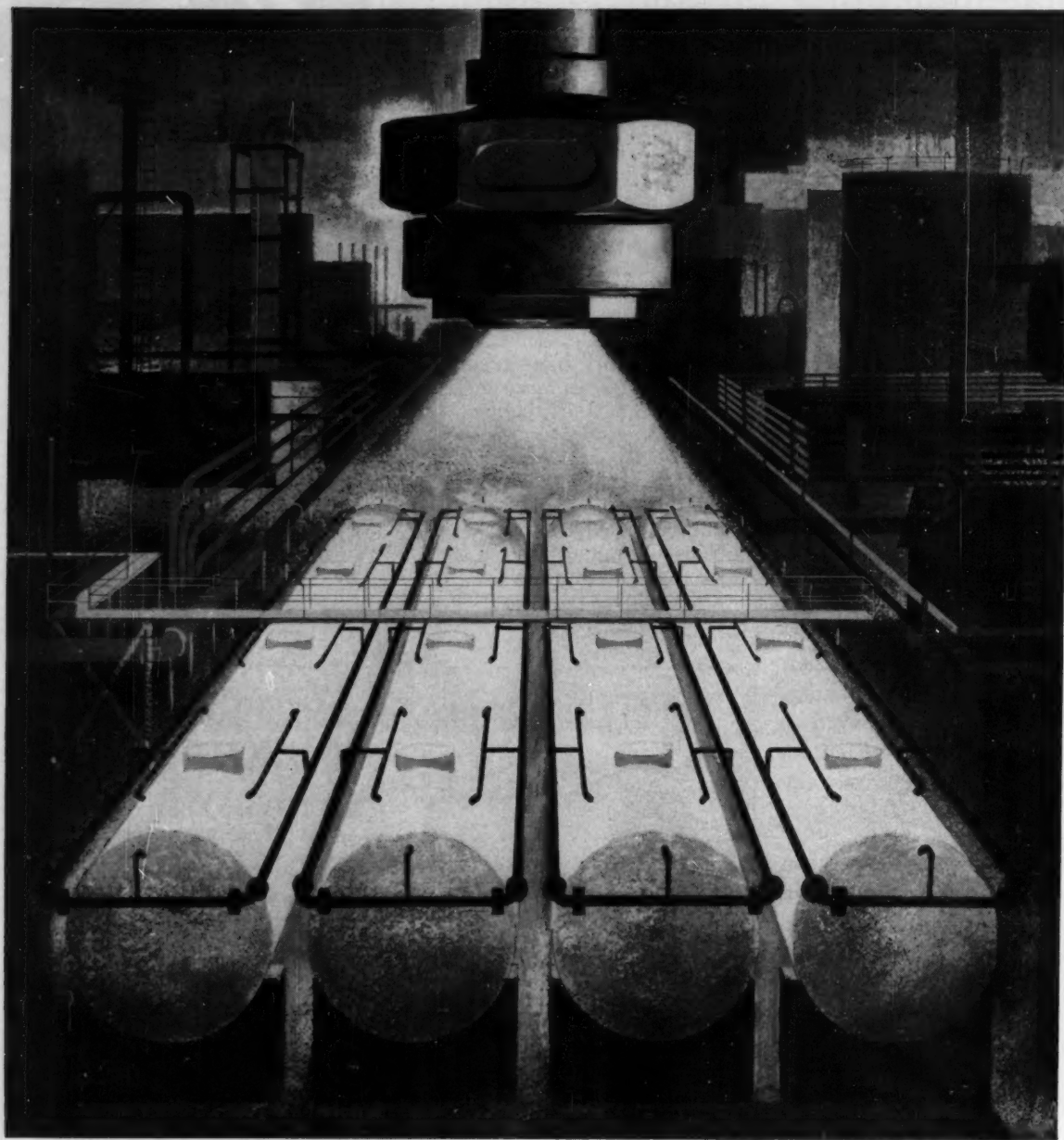
VANTON PUMP & EQUIPMENT CORP.



STAINLESS ENGINEERING AND MACHINE WORKS DIVISION



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**give your plant and equipment the best fire protection—
a BLAW-KNOX automatic fog system**

"Little Joey
Sprinkler
always on
the job"



BLAW-KNOX Automatic Fire Protection Systems are engineered to provide positive protection for your plant and processing, storage, and other equipment. If a fire breaks out, the system goes into action immediately:

- alarms sound
- fire smothered promptly
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Why not give your plant and equipment the **BEST** possible protection. Let a Blaw-Knox *fire-protection* Engineer study your needs. He will gladly submit a layout and a cost estimate . . . with no obligation to you.

BLAW-KNOX COMPANY

*Automatic Sprinkler Department
Pittsburgh 33, Pennsylvania*

High Speed Reduction to Micron Sizes — No Attritional Heat!

Production Model
(15 in. diameter
grinding chamber)

Laboratory Model
(2 in. diameter
grinding chamber)

ENGINEERING FLUID-JET GRINDING IN "PACKAGE UNITS"

... comes naturally to Sturtevant engineers — with their 75-year tradition of successful solving of dry-processing problems. If you want to accomplish the most effective grouping of a Micronizer* Grinding Machine with necessary compressor, feeder and dust-collector, it will pay you to investigate. Check the coupon on the right for more information.

Sturtevant Micronizer* Grinding Machines Give Greater Finenesses than Tube or Roller Mills

Look at the record! 30 inch model reduced titanium dioxide to 1 micron and finer at solid feed rate of 2250 lbs. per hr. 24 inch model reduced DDT (50%) to 3.5 average microns — 1200-1400 lbs. per hr. 8 inch model reduced Procaine—Penicillin—to 5 to 20 microns—up to 20 lbs. per hr. Couldn't you use milling performances like these?

No moving parts. The particles grind each other. High-speed rotation and violent grinding impact of particles are caused by jets of compressed air or steam at angles to the periphery of the shallow grinding chamber. There are

no problems of attritional heat. Centrifugal force keeps over-sized particles in the grinding zone. Cyclone action in the central section classifies and collects the fines for bagging.

Instant accessibility, easy cleaning. Micronizer* Grinding Machines come in seven sizes — each one constructed for quick accessibility and easy maintenance (typified by the "OPEN DOOR" design in other Sturtevant equipment). Grinding chambers range from the 2 in. laboratory size with ½ lb. per hr. capacity to the 30 in. size which handles up to 3000 lbs. per hr.

* Registered trademark of Sturtevant Mill Co.

STURTEVANT

Dry Processing Equipment

The "OPEN DOOR" to lower operating costs over more years

CRUSHERS • GRINDERS • MICRON-GRINDERS • SEPARATORS
BLENDERS • GRANULATORS • CONVEYORS • ELEVATORS

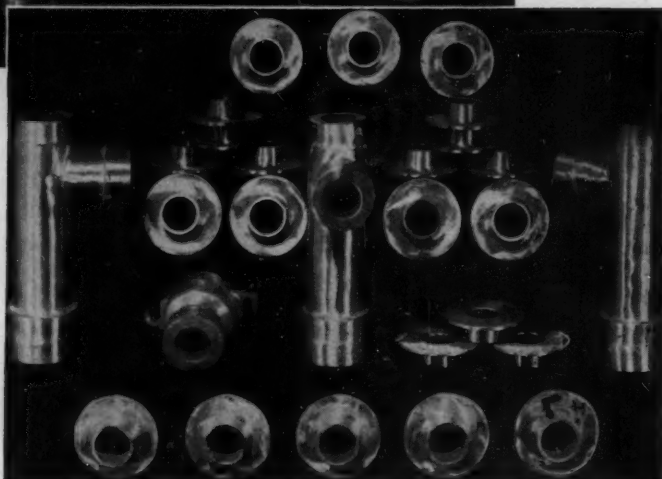
My dry-process materials are: _____
Desired capacity is: _____
Name _____ Title _____
Firm _____
Street _____
City _____ Zone _____ State _____

STURTEVANT MILL COMPANY 100 Clayton Street, Boston 22, Mass.

Please send me your Micronizer* Bulletin ☐

Also bulletins on machines for:

- ☐ CRUSHING ☐ GRINDING ☐ PULVERIZING
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This is the mark that means
clean, sound Stainless Castings all the time



Write for this book on
**AL STAINLESS STEEL
CASTINGS**

32 pages of valuable and complete data on stainless castings: analyses, properties, technical data on handling and heat treatment, typical applications, how to order, etc.

ADDRESS DEPT. CE-76

Every stainless casting produced by our Buffalo Foundry carries the familiar "AL Star" trademark, cast into the steel. That means it's Allegheny Ludlum *time-tested* stainless steel—a pioneer that has successfully answered thousands of difficult corrosion and heat resisting problems.

It not only means experience in stainless casting applications, but in maintained high quality, too. The AL Buffalo Foundry is a pioneer in both the vertical-centrifugal and static methods of casting

stainless steel. You can depend upon AL Stainless Steel Castings to be strong, clean-surfaced, sound-structured and easy-machining . . . fully in accord with the service conditions and with your requirements for delivery.

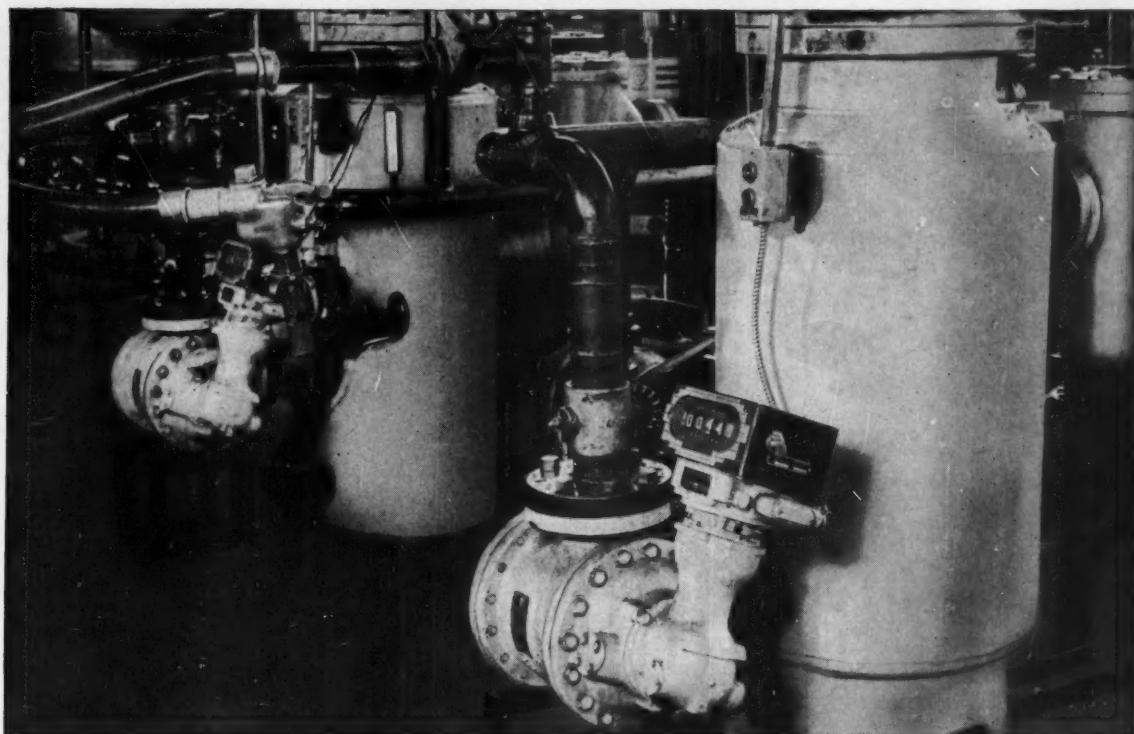
Let our stainless foundry specialists quote on *your* problem jobs—any shape casting or any size, up to thousands of pounds. • **Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pennsylvania.**

WSW 8007 C

For Stainless Steel in ALL Forms—call
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With Rockwell Industrial Meters you will eliminate the human error in handling liquids and compounding formulas. By supplanting time consuming weight or gauge methods, you'll save money. With a closed metered piping system you can avoid hazards and contamination. And remember, since Rockwell meters are available in a wide variety of metals (including stainless steel) you can measure most any liquid that can be piped. Let our engineers advise on your services. Write or use the handy coupon.

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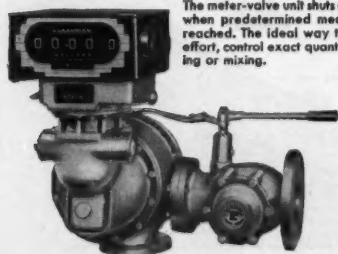
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The meter-valve unit shuts off automatically when predetermined measured volume is reached. The ideal way to save time and effort, control exact quantities when batching or mixing.

Provides Pre-Set Meter Shut-off Without Shock!

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Gentlemen:

I am interested in measuring _____

(Name of Liquid)

Pipe Size _____"

Working Pressure _____ psi

Temperature _____ °F max.

Max. Flow Rate _____ gpm

Min. Flow Rate _____ gpm

Your Name _____

Company _____

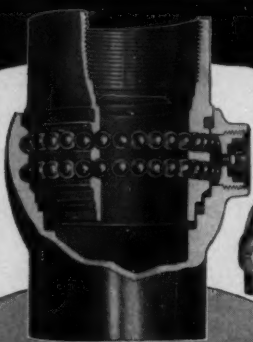
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City _____

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**STEEL
BRONZE**

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OPW

swing joints

**FULL UNRESTRICTED FLOW • EFFORTLESS MOVEMENT
GREATER LOAD CARRYING CAPACITY • "O" RING SEALED
CONTAMINATION FREE OPERATION • PERFECT ALIGNMENT**

The wide range of sizes and styles of OPW BALL BEARING SWING JOINTS offers many and varied applications for safely handling liquids of diversified viscosity at required temperatures and working pressures.

Millions of gallons of all types of liquids are moved daily in flow lines where perfectly sealed, rotating OPW Swing Joints provide an almost limitless range of flexible operations.

Join other users of OPW Swing Joints. You can also realize economies in your liquid products handling.

Free Catalog F-8

provides engineering data, sizes, styles, recommendations and prices.



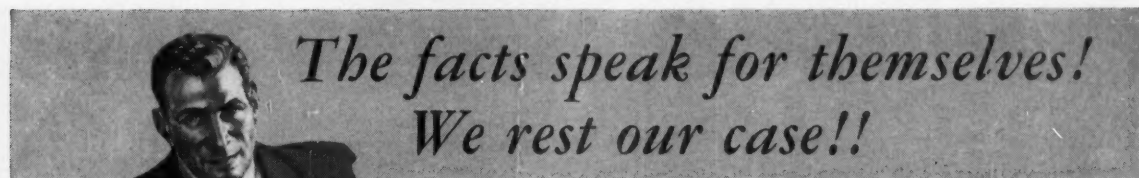
SWING EASY!

FLOW EASY!



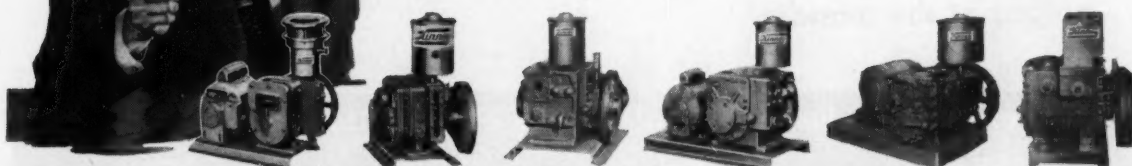
OPW CORPORATION

2725 COLERAIN AVE., CINCINNATI 25, OHIO

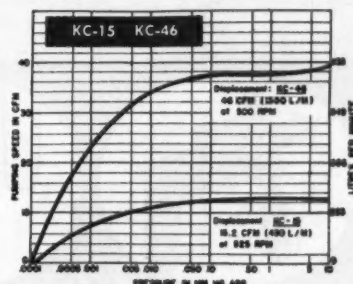
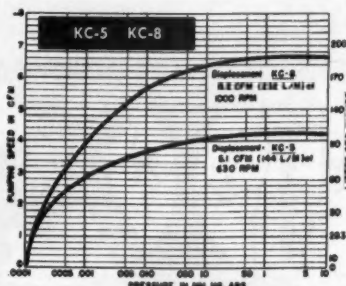
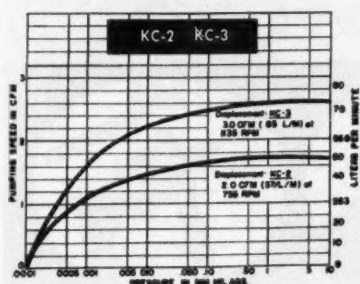


The facts speak for themselves!
We rest our case!!

KINNEY COMPOUND HIGH VACUUM PUMPS



SPECIFICATIONS	MODEL KC-2	MODEL KC-3	MODEL KC-5	MODEL KC-8	MODEL KC-15	MODEL KC-46
Free Air Displacement . . .	2.0 CFM	3.0 CFM	5.1 CFM	8.2 CFM	15.2 CFM	46.0 CFM
Free Air Displacement . . .	56.5 Liters/min.	85.0 Liters/min.	144. Liters/min.	232. Liters/min.	430 Liters/min.	1300 Liters/min.
Free Air Displacement . . .	.95 Liters/sec.	1.41 Liters/sec.	2.4 Liters/sec.	3.9 Liters/sec.	7.2 Liters/sec.	21.7 Liters/sec.
RPM	755	1135	630	1000	525	500
Motor H.P.	1/4	1/2	1/2	1/2	1	3
Motor RPM (syn.)	1800	1800	1800	1800	1800	1800
Oil Capacity	6 oz.	6 oz.	1 1/2 pt.	1 1/2 pt.	2 qt.	1 gal.
Shaft Diam.	3/8"	3/8"	3/8"	3/8"	3/8"	1 1/8"
Inlet Connection	3/4" Screwed	3/4" Screwed	1" Screwed	1" Screwed	2" Screwed	3" Screwed
Outlet Connection	None	3/4" Screwed	1" Screwed	1" Screwed	1 1/4" Screwed	1 1/2" Screwed
Net Weight, Complete . .	70 lb.	78 lb.	140 lb.	148 lb.	300 lb.	585 lb.



SUMMATION

- Reliable High Vacuum (Cam and piston displacement)
- Rapid Recovery of Vacuum
- Simple to Maintain
- Dynamically Balanced
- Standard Small Motors
- Gas Ballasted (optional)
- Economical
- Dependable
- Small, Compact Design

VERDICT

Your verdict will be FAVORABLE when you review all the facts. Request Bulletin 403 for additional data or contact one of our competently staffed district offices in Baltimore, Chicago (LaGrange), Cleveland, Los Angeles, New York, Philadelphia, San Francisco, or St. Louis.

write

today

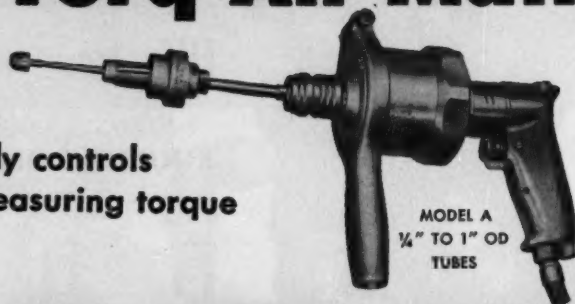
KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY
3551 WASHINGTON STREET • BOSTON 30 • MASS.
INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N.Y.

- PLEASE SEND BULLETIN 403 giving complete data on Kinney Compound Pumps
- Our vacuum problem involves _____

Name _____
Company _____
Street _____
City _____ State _____

New WILSON Torq-Air-Matic

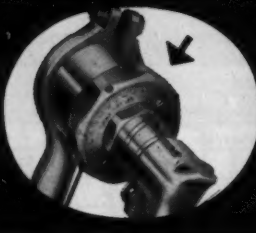
First and only air-driven tube expander drive that accurately controls tube expansion by directly measuring torque output at the mandrel.



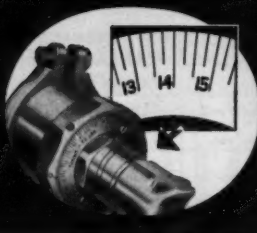
Look at these exclusive design features of the WILSON Torq-Air-Matic



AIR-DRIVEN—Only air-driven tube expander drive with a built-in torque control. Does not require a separate control box, relays or switches. No extra cables or wires; just one small air hose serves it.



CALIBRATION—The only tube expander control calibrated in terms of foot pounds torque instead of meaningless arbitrary units. Torque requirements for expanding tubes of off-standard jobs can be more readily arrived at.



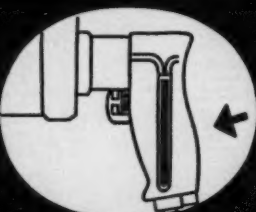
POWERFUL—Rated to deliver fourteen foot pounds torque at 90 psi. This is sufficient to roll 1" OD x 11 gauge boiler tubes.



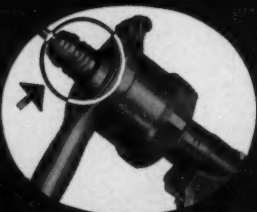
SIMPLE—Only a single three-position trigger throttle for off, forward and reverse. Never any danger of over-rolling because of improper sequence of operation. No juggling of switches; nothing new to learn.



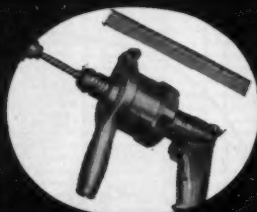
CONVENIENT—Furnished with an auxiliary handle that can be swivelled to any position desired by the operator or left off when the torque reaction is not too great. Basic unit is of a pistol grip design.



TROUBLE-FREE—Has an oil reservoir built into the handle to supply lubrication to the motor. The control section is independent of the motor and lubricated for life.



CHUCK—Simple, new type, snap on floating chuck. Only one motion instantly engages or disengages a square shank mandrel—no set screws.

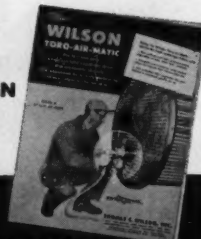


COMPACT—Only 10" overall from pistol grip handle to instant action chuck.

These features speak for themselves. The Wilson air-driven Torq-Air-Matic tube expander drive and control is an important revolutionary advance in the field of precise tube expanding. Here's what you get when you use the Wilson Torq-Air-Matic control

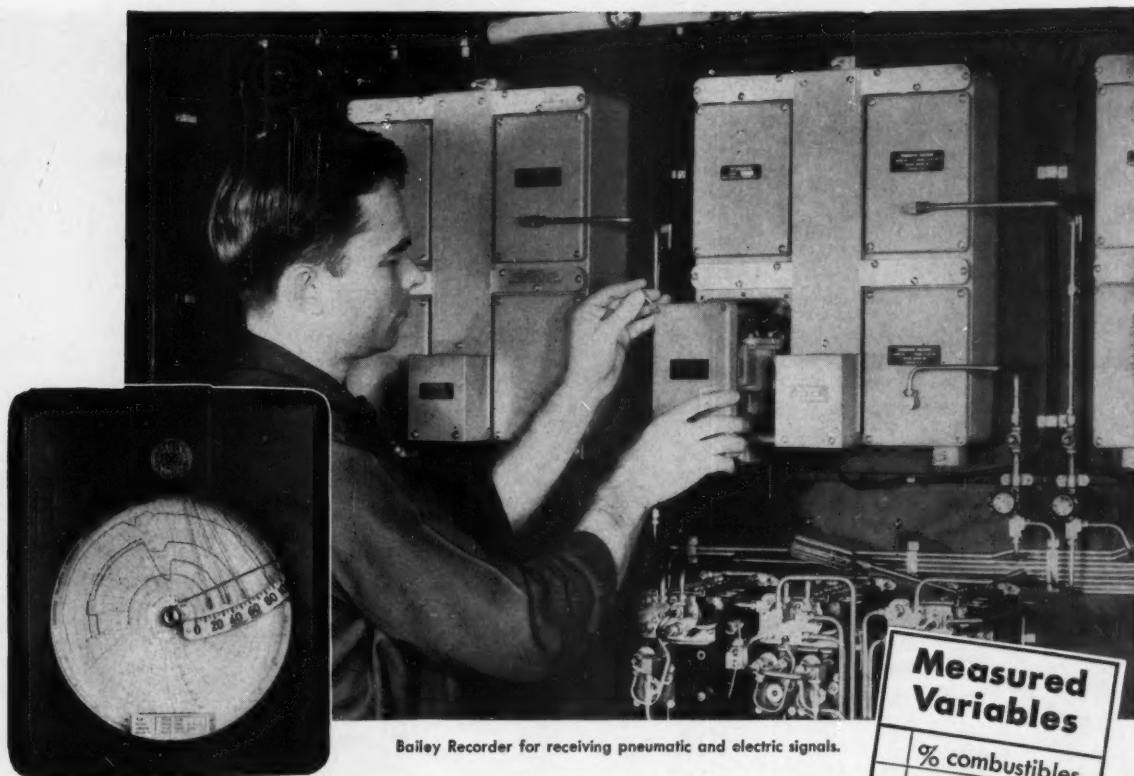
for heat exchanger tubes: (1) uniform and tight pressure joints, regardless of tube sheet hole variation; (2) no over-rolled or under-rolled tubes—no stresses that shorten tube life; (3) extended tube expander life, more production, higher profits.

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FOR
BULLETIN
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Bailey Recorder for receiving pneumatic and electric signals.

Pick any four, plug in, and record

Here is a receiver recorder, custom-built *by you* to meet your needs, no matter how changeable, how complex. On a single chart you can record any four measured variables—and interchangeable receivers permit new combinations almost at will.

Individual plug-in pneumatic or electronic receivers—and corresponding integrators—are interchangeable in the four identical frame slots. You can select any combination; even including two receivers and their two integrators.

Think what this can mean to you! Parts inventories are minimized; re-use of components keeps instrumentation costs economically low when cycle changes are frequent—and you can even tie in with your existing transmitters.

Ask for Product Specification E12-5.

Measured Variables	
% combustibles	
combustion	
conductivity	
density	
differential	
draft	
flow	
liquid level	
% oxygen	
pH	
position	
pressure	
ratio	
smoke density	
specific gravity	
speed	
temperature	
vacuum	

PDS-1



ONLY BAILEY OFFERS ALL THESE ADVANTAGES IN A SINGLE RECORDER

- Pre-calibrated plug-in receiver units
- Up to four pneumatic or electronic receivers—or two receivers and two integrators
- Any four variables on one chart—easily read and interpreted
- A full year's ink supply at one loading
- Faster ordering—from stock
- Minimum inventory of parts
- Minimum instrument investment for process cycle expansion or alteration

BAILEY

METER COMPANY

1054 IVANHOE ROAD

CLEVELAND 10, OHIO

Controls for Power and Process

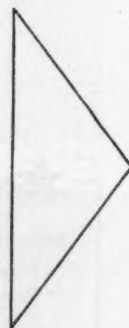


Controls for
TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW LEVEL
RATIO DENSITY



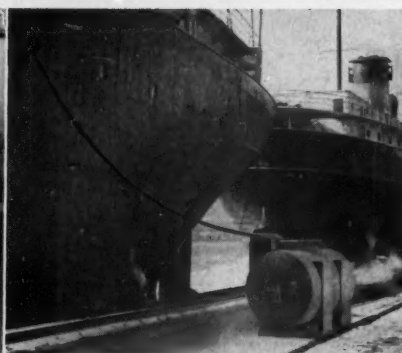
Here's **MASS-HANDLING** of bulk

What you see above is a Dempster-Dumpster serving one of its detachable containers. Multiply this simple pick up, haul and dump operation by scores of steel containers built to meet your requirements for handling waste or salvable materials, raw and finished products, fluids including acids, combustibles, dusty materials, etc. You have, then, mass-handling of bulk materials with one truck and one man!





Tilt Type Container is handling filter dirt at a plant in Illinois. Note container is equipped with casters and placed under chute, through which the filter dirt passes directly from presses. As each container is filled, it is replaced with an empty one.



Tank Type Container is being filled with used oil from a ship. Time required to haul loaded container to reclaim station, drain and return for refilling—10 minutes. Time cycle of the former method using conventional barrels—60 minutes.

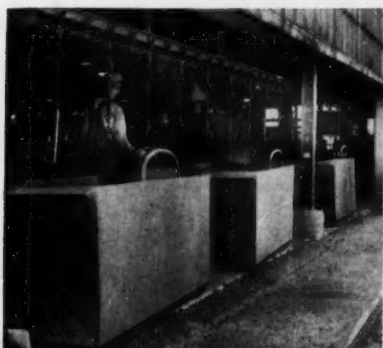


A loaded Apartment Type Container, equipped with roller bearing casters, is being rolled to outside of this plant building. Dempster-Dumpster will pick it up, haul to disposal area, dump the refuse and return empty container for refilling.

Three heavy duty Drop Bottom Type Containers, shown below, are loaded with cast iron fittings from conveyor at plant in Birmingham. Dempster-Dumpster picks up each container when loaded and hauls the finished products to shipping department.

Here's another example of the many types of waste materials handled by this system. The Skip Type Container shown below is located under hydropulper at a paper plant. Picture was shot while container was being filled with rope waste sludge.

Waste materials are loaded into these Universal Containers at a food plant warehouse. Containers have lids in top, as well as a door in each end, which are opened to make deposits, then closed, sealing materials in container.



materials with one truck...one man!

A FEW OF THE HUNDREDS of containers available are shown above in actual service. They are built in capacities up to 21 cu. yds.—several times the capacity of the average dump truck body. One Dempster-Dumpster, operated by only one man, the driver, serves scores of big detachable containers, one after another—handling materials of every description. It's like having one truck with scores of bodies!

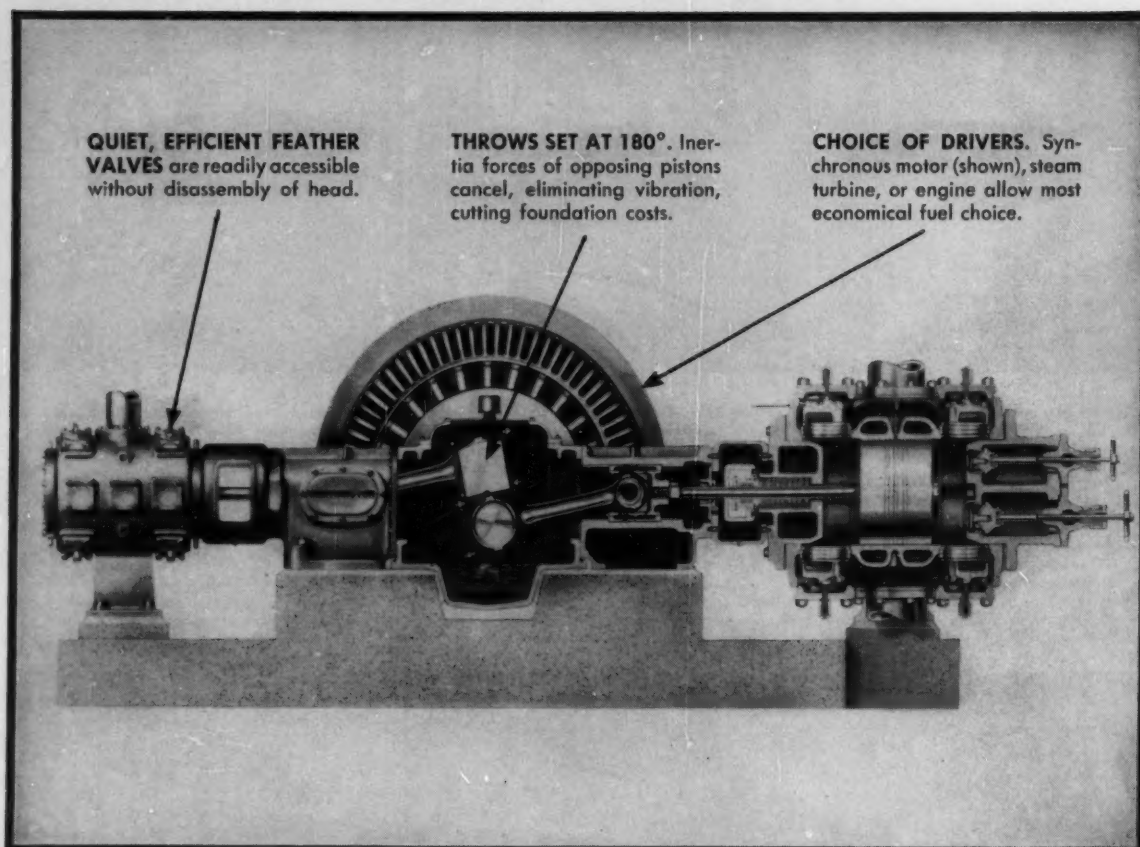
Records of performance in dozens of installations prove beyond question that savings are tremendous! The Dempster-Dumpster System cuts costs of equipment and operation. It is common knowledge that one Dempster-Dumpster will perform the work of several conventional trucks, reducing investment ac-

cordingly. This system eliminates standing idle time and re-handling of materials. Once placed in these containers, materials remain there until hauled to destination. Efficiency, sanitation and good plantkeeping are big advantages. Materials to be transferred or disposed of are constantly being placed in the containers as they accumulate. Containers for handling refuse are fire-proof, rat-proof and scavenger proof.

With no obligation on your part, our engineers will be glad to make a comprehensive fact-finding survey to determine the cost-cutting possibilities of this equipment in your plant. Write us for complete information today! Manufactured exclusively by Dempster Brothers, Inc.

DEMPSTER BROTHERS

246 Dempster Building, Knoxville 17, Tennessee



CUTAWAY VIEW of Worthington's new balanced-opposed compressor shows double-throw crankshaft with cranks set at 180 degrees. Reciprocating weights of pistons always

travel in opposite directions, cancelling out all inertia forces. Result: fewer vibration problems; consequently, simpler foundation.

New balanced-opposed compressor handles multi-services all at once

When you have process requirements existing at different low-temperature levels, you don't need a battery of compressors. All you need is one Worthington balanced-opposed unit — with only one driver.

The new balanced-opposed compressor is specifically designed to handle single or cascade refrigeration duties. What's more, you can combine on the same frame refrigeration loads with gas compression, similar to that encountered in chlorine condensing and carbon dioxide liquefaction systems. Result: a big saving in installation and operating costs.

Here are more cost-cutting features:

BALANCED-OPPOSED PRINCIPLE (which virtually eliminates transmission of unbalanced shaking forces to foundation) plus simple frame design permit use

of smaller, less expensive foundation.

FEATHER* VALVE OPERATION. Worthington's exclusive Feather Valve provides unusually high compression efficiency — bringing power costs 'way down.

MINIMUM MAINTENANCE COSTS — made possible by quick, easy accessibility to all compressor cylinders and running gear.

WIDE CHOICE OF DRIVERS — synchronous motor, steam turbine, internal combustion engine — whatever drive is easiest, cheapest for you to use.

You can get the Worthington balanced-opposed compressor in sizes from 300 HP all the way up to 10,000 HP. Write for details today to Worthington Corporation, Air Conditioning and Refrigeration Div., Section A.5.60-CG, Harrison, N.J.

A.5.60

*Reg. U.S. Pat. Off.

WORTHINGTON



CLIMATE ENGINEERS TO INDUSTRY, BUSINESS AND THE HOME

Using Salt Efficiently

by **INTERNATIONAL SALT COMPANY, INC.**—America's largest producer of salt



Unloading Bulk Salt From Boxcars—at Lower Cost

While salt is a relatively low-cost material, handling it often involves considerable expense in time and manpower. Unloading bulk salt from boxcars, for example, has always been one of the problem spots. Today, however, a number of money-saving unloading methods have been developed for large and small plants.

Determining which of these modern salt unloading methods is best for your company depends on the tonnage involved, and specific plant requirements. But you can generally find one which will pay for itself—in savings on time and labor—over a relatively short period. Here is a review of four practical salt unloading methods, and the equipment used in each.

Portable conveyor system. This is the simplest improvement over straight manpower. A power-operated belt conveyor of suitable length is placed inside the car door, and salt is then shoveled onto it. Conveyors may be used to bring salt directly into the plant—or even to storage areas above dock level. A good

conveyor for most needs is generally about 16 to 18 feet long and capable of moving salt up a 30° slope. With a conveyor, a good deal of manpower in shoveling is required, but one 40-ton car can be unloaded in about 12 to 14 man-hours—a 19% saving in time over straight manpower.

Scoop truck and conveyor. A scoop truck is simply an enlarged scoop shovel with two small wheels at the bowl of the scoop. Whereas a shovel holds only about 20 lb. of salt—a scoop truck holds 100 to 150 lb. In operation, the scoop is pushed into the salt, tilted up, and then wheeled to the conveyor at the car door. With just one of these scoops, a worker can unload 40 tons of salt in 10 hours—and once the job is under way, there is room for two or three more men with scoops. An



important point: A good scoop truck costs only about \$50.

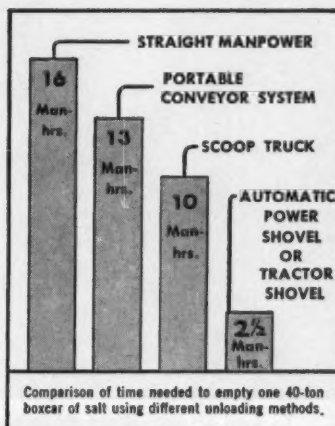
Automatic power shoveling. This is one of today's most popular methods for unloading bulk salt—and many manufacturers offer excellent power-shovel equipment. Basically, the device consists of a large power-operated scraper blade mounted on a cable. The scraper is moved toward the end of the car, and as soon as this motion stops, a power winch takes hold to drag the scraper toward the car door. Salt is pushed out through the door by the scraper. One man can unload a 40-ton car in 2 or 3 hours by this unique method. Both winch and motor for the power shovel must be permanently mounted on the dock or side of the building—but the installed cost of this equipment is moderate.

Small gasoline or electric tractor shovel, somewhat similar to a fork-lift truck, but with a scoop mounted in place of the forks. Many types are available, some having forks interchangeable with the scoop. One man on this type of truck can empty a 40-ton car in 2 to 3 hours—the equivalent of



power-shovel unloading. The higher cost of a tractor shovel, however, is often justified when it can be made available for other purposes.

Extra savings are possible with tractor shovels with scoop attachments. These



trucks not only move salt out of the boxcar, but also transport it to any point of storage or use within the plant. This eliminates the need for various types of conveying equipment—either on the dock or in the plant. And manpower for handling salt in the plant is considerably reduced.

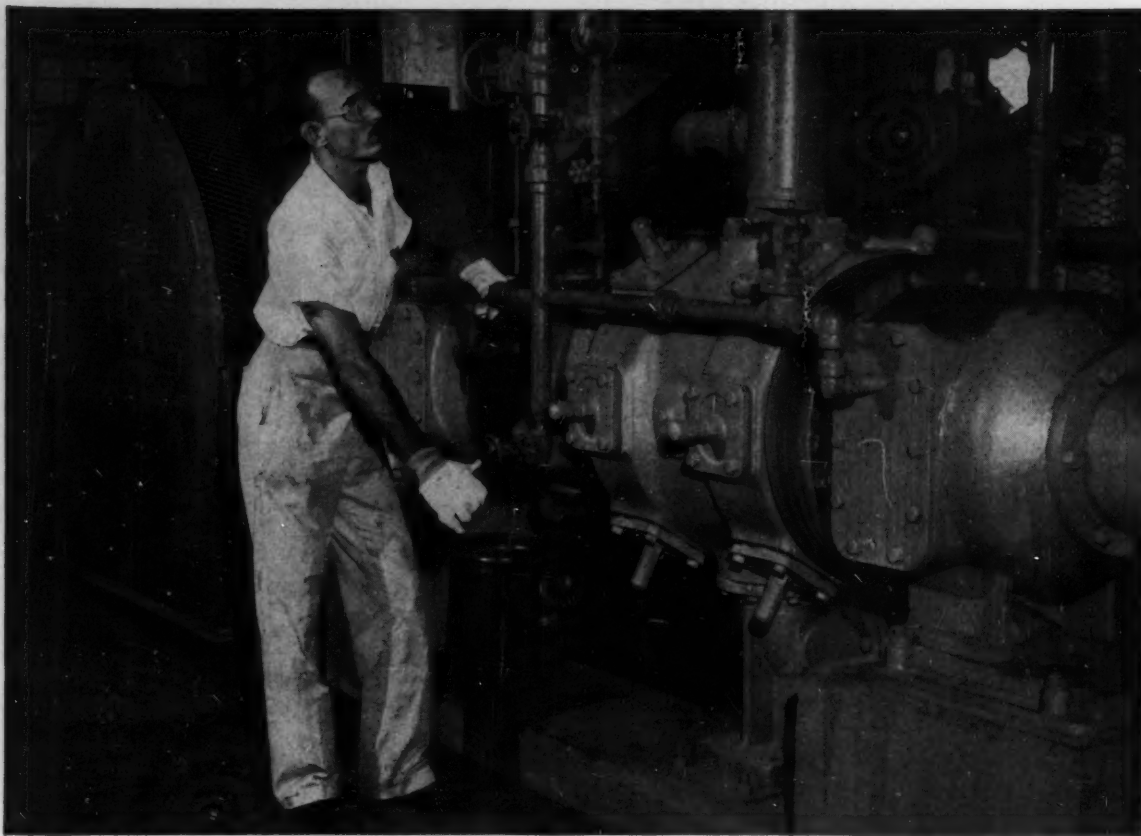
TECHNICAL SERVICE WITH YOUR SALT

Through skilled and experienced "Salt Specialists," International can help you get greater efficiency and economy from the salt you use. International produces both Sterling Evaporated and Sterling Rock Salt in all grades. And we also make automatic dissolvers in metal or plastic for both types of salt. So we have no reason to recommend one type of salt over another; we simply suggest the type and grade of salt most perfectly suited to your needs.

If you'd like help on any problem concerning salt or brine—or further information on salt unloading—contact your nearest International sales office.

International Salt Company, Scranton, Penna.
Sales offices: Atlanta, Chicago, New Orleans, Baltimore, Boston, Detroit, St. Louis, Newark, Buffalo, New York, Cincinnati, Cleveland, Philadelphia, Pittsburgh, Richmond.

FOR INDUSTRY, FARM, AND THE HOME—
STERLING SALT
PRODUCT OF INTERNATIONAL SALT CO., INC.



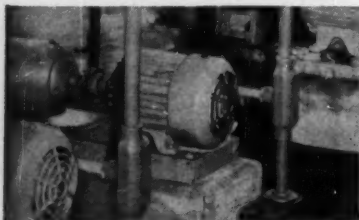
To ward off corrosion troubles in this chlorine compressor, contact parts are made of high-nickel alloys. Cylinder lines, packing cases, packing-ring springs,

stuffing-box case and valve parts are Monel nickel-copper alloy. Other parts are heat-treated "K" Monel alloy or "S" Monel hard-grade nickel-copper cast alloy.

How Monel stalls trouble in dry-chlorine-handling equipment

In equipment handling dry chlorine, Monel® nickel-copper alloy establishes a twofold control over corrosion.

First, Monel resists dry chlorine and hydrogen chloride, even at temperatures up to 800°F.



Pumps transferring dry chlorinated hydrocarbons containing some chlorine and hydrogen chloride use mechanical seals of Monel alloy or Nickel. Nickel alloys protect against corrosives formed in humid atmosphere.

Second, Monel nickel-copper alloy is one of the few metals that resist low concentrations of hydrochloric acid formed when traces of moisture are present and temperature is below the dew-point — as often occurs in batch chlorinations.

Chlorine Institute standardizes on Monel

In shipping chlorine, it is standard practice to use valves with Monel alloy stems, seats and trim on most types of containers. The same corrosion-resisting alloy is used for chlorine compressor parts, pumps, orifice plates and other equipment that must preserve close tolerances.

When other factors enter in . . .

Look to other high-nickel alloys to take care of them. Inco's Development and Research Division will help you select materials to withstand specific conditions. And write for Inco's 28-page bulletin, "Resistance . . . to Corrosion by Hydrochloric Acid, Hydrogen Chloride, and Chlorine."

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.



Nickel Alloys

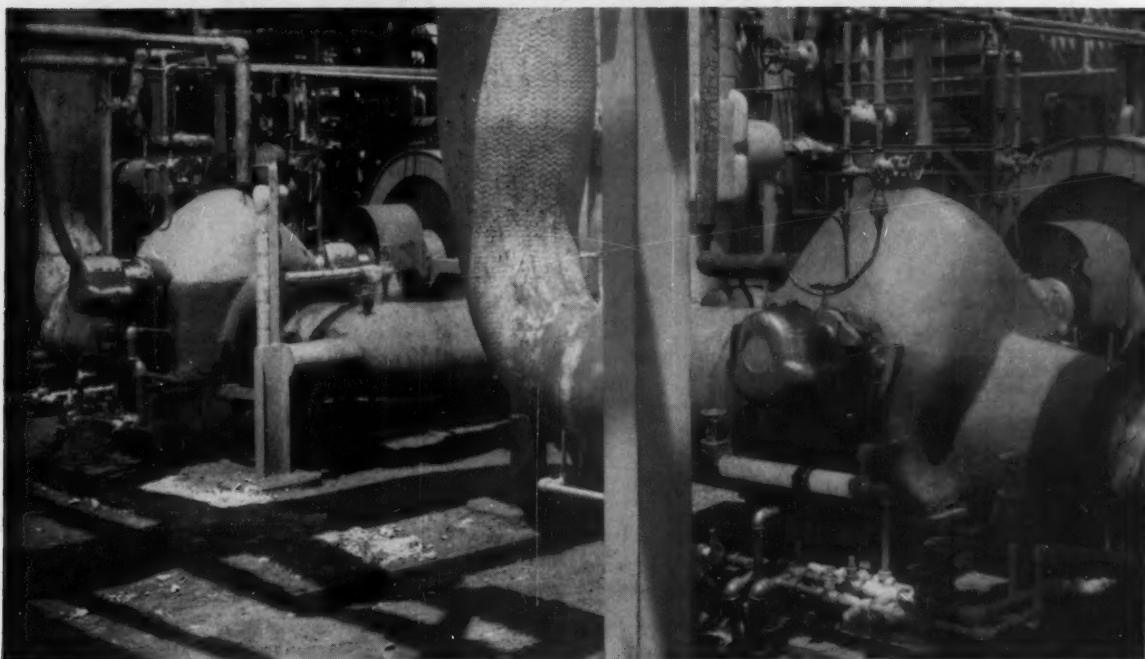
*Registered trademark

Monel . . . for minimum maintenance

April 1956—CHEMICAL ENGINEERING

Allis-Chalmers

PUMPS Solve a Chemical Industry Problem



All-Stainless-Steel Pumps Handle Hot Corrosive Liquids

Manufactured on duty-specifications from the customer, these Allis-Chalmers Type SG stainless steel pumps are successfully handling a highly corrosive mixture of carbonate, urea, oil, and water at 260 F.

This is another example of the way Allis-Chalmers serves the chemical industry with a wide range of types of pumps in all sizes. These versatile, high efficiency Allis-Chalmers pumps are available in many special materials to meet specific application requirements.

For full information on how Allis-Chalmers can help you reduce costs, contact your local Allis-Chalmers district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



A-4983

ALLIS-CHALMERS

**You Get MORE
when you Get
ALLIS-CHALMERS**

You can benefit from Allis-Chalmers years of experience in pump manufacturing for all industries. The design and engineering skill resulting from this experience is at your service — you get special construction pumps that give top performance and low operating costs.

Allis-Chalmers industry-experienced engineers will help you select exactly the Allis-Chalmers pump to meet your needs, and Allis-Chalmers can furnish a complete pump unit—pump, motor, and control.

New Chemical Process Wins Chrome From Ore

Pioneering plant treats low-grade ore, clears way to . . . Pure chromium deposition.



CHEMICAL digestion step removes impurities from ferrochrome.



CELL design calls for plastics.

AFTER much pilot-plant work, the wraps are now off Electro Metallurgical's new chemical-electrolytic process for making high-purity chromium metal.

Boasting major innovations in the preparation and purification of chrome solutions, as well as in the design of corrosion resistant electrolytic cells, the process is designed around substandard—but domestic—ores.

Many experts believe Electro Metallurgical's new 2,000 tons/yr. Marietta, Ohio, chromium plant—where the process is proving itself—will lead the way in cutting U. S. chromium production free from dependence on foreign ore sources (Transvaal, Rhodesia).*

Most of the metal from the plant goes to meet a rising demand for chromium in high temperature nickel and cobalt base alloys (jet engines, gas turbines, rockets). Actually this

demand spurred much of the development work on the process.

► **What Goes on at Marietta?**—Success of the process hinges on smooth integration of chemical processing with continuous electrodeposition of chromium (see flowsheet).

First, high-carbon ferrochrome (25% Fe, 65% Cr)—made by reducing domestic chrome ore containing 42% Cr_2O_3 and 20% FeO with coke in an arc furnace—is dissolved in sulfuric acid (oleum). The solution is cooled to remove iron as ferrous ammonium sulfate. Chromium, recovered as ammonium chromium sulfate (chrome alum), is dissolved in water to make cell feed. High-purity chromium deposits in specially designed electrolytic diaphragm cells.

► **Critical Step**—One key to the process is the important leach-digestion step. Here chromium dissolves in a solution made up of sulfuric acid, spent reduced cell liquor and chrome alum

mother liquor. Leaching and digestion take about 48 hr. During this time large volumes of hydrogen are given off and removed by a ventilating system. This digestion reaction, carried out in a brick-lined steel tank, leaves most of the non-metallic impurities (silica) undissolved, and clears the way for efficient production of pure chromium.

After digestion, the slurry drops into a holding tank where it's cooled to below 175 F. with ferrous ammonium sulfate mother liquor. Undissolved solids are separated from solution in rubber-covered leach filters. The residue is washed with water and discarded.

Filtrate advances to a brick-lined steel conditioning tank where, while the solution is held at elevated temperatures for two hours, chromium forms a non-crystallizing form of the chrome alum coordinate compound $\text{NH}_4\text{Cr}(\text{SO}_4)_2 \cdot 12 \text{H}_2\text{O}$.

► **Iron Sulfate Circuit**—Conditioned liquor is pumped to a rubber-lined batch vacuum crystallizer. Here at 41 F. crude iron sulfate crystals separate out and are removed on acid-proof drum vacuum filters.

Iron sulfate crystals are dissolved in wash water from the leach filter, and ammonium sulfate added—forming ferrous ammonium sulfate. This is then filtered, dried and sold as fertilizer.

► **Treating Mother Liquor**—Filtrate from the drum vacuum filter goes to aging tanks—Koro-

* Usually chromium is made commercially from imported ore by the electrothermic process: reduction of ore ($50\% \text{Cr}_2\text{O}_3$) with silica or aluminum in an electric furnace.

seal-lined steel thickeners, designed to hold a 10 days supply of mother liquor. Here is where the non-crystallizing form of chrome alum transforms to the violet crystals at 85 F.

About 80% of the chromium comes out as alum. Crystals are filtered and washed on a horizontal filter. Mother liquor goes to the leach tank, and the washed crystals are dissolved in hot water to make cell feed.

► **Electrolytic Circuit**—Successful electrodeposition of chromium requires control of pH of the cathode solution (catholyte). Also sulfuric acid and chromic acids formed at the anode must not mix freely with the catholyte or oxidation of the chromium ion will take place.

Mixing is controlled with diaphragms of limited porosity. The pH is controlled by regulating the amount of catholyte flowing through the diaphragms into the anolyte chamber. Increasing the catholyte flow increases the ammonium ion and lowers the hydrogen ion concentrations.

► **Cell Construction**—Cells are equipped with ventilating systems for removing hydrogen. Tanks are glass cloth bonded to polyester resin. The cells are arranged in two banks of 44 cells each, supplied with direct current from 10,000 amp. generators.

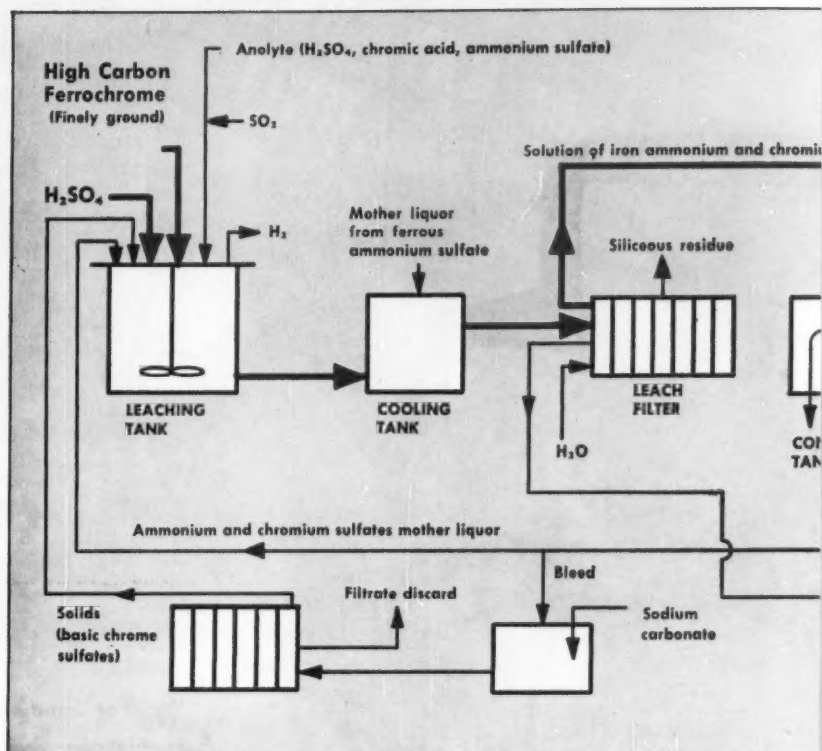
Cell feed is continuous, but to cut down on viscosity, it's mixed with a stream of recirculating catholyte.

Spent anolyte (chromic and sulfuric acids and ammonium sulfate) is treated with sulfur dioxide in packed towers prior to addition to the leach tank to reduce chromic acid to chromium ion. Spent catholyte containing divalent chromium is sent to the aging tanks.

► **Stripping the Metal**—The Type 316 stainless steel cathodes are withdrawn from the cells on a 72-hr. cycle. Salt incrustations are removed in hot water.

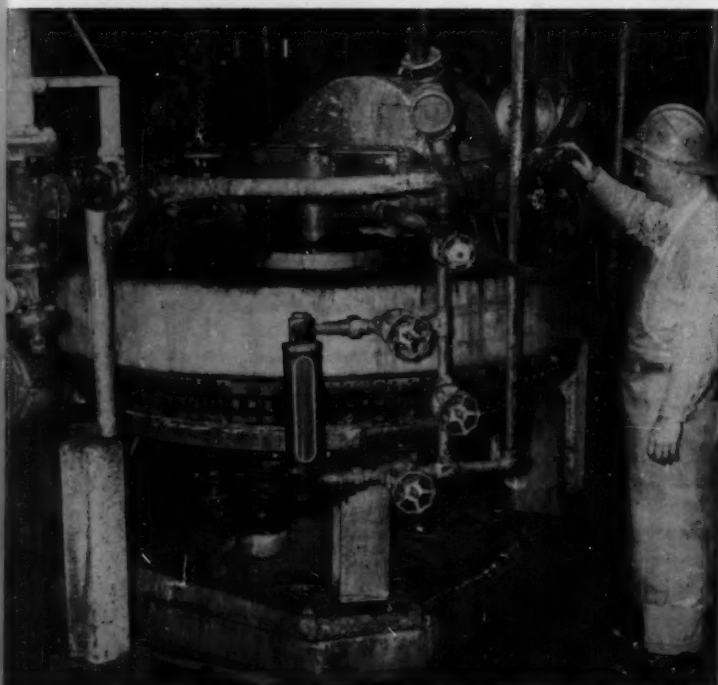
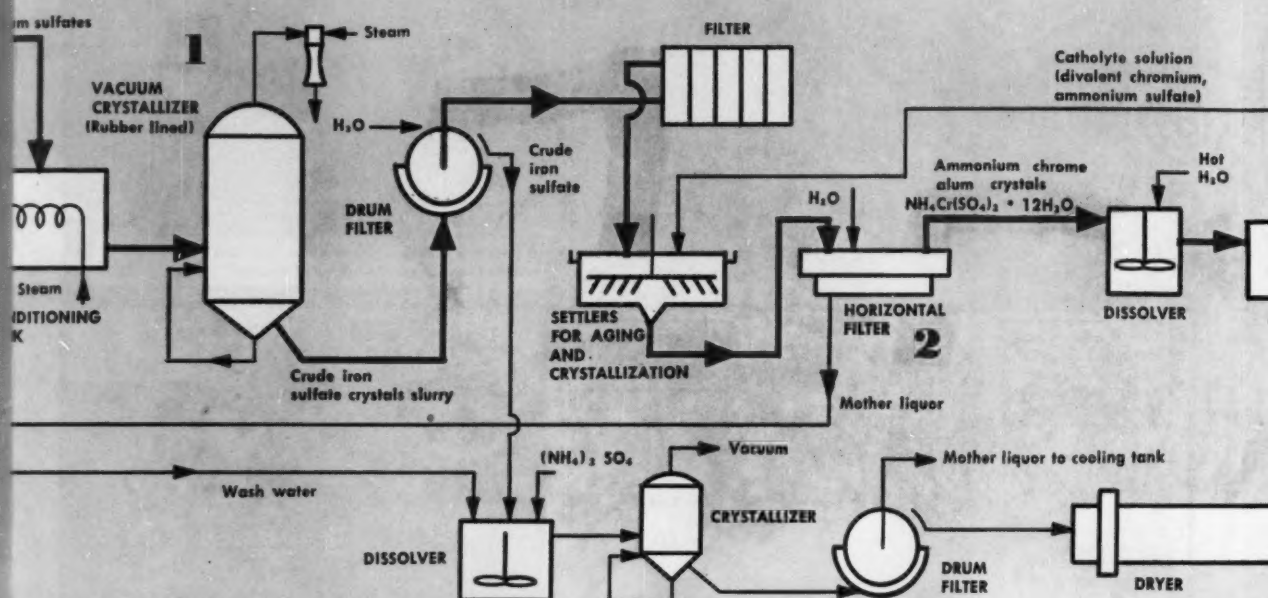
The brittle chromium deposit ($\frac{1}{8}$ to $\frac{1}{2}$ -in. thick) is then stripped off with air hammers, and the deposit crushed and washed, then dried and packed.

Cathodes are blasted with metal grit, straightened, degreased and returned to the cells.



VACUUM CRYSTALLIZERS remove iron from chromium solution as iron sulfate crystals at 41 F. These crystals are separated on drum filters.

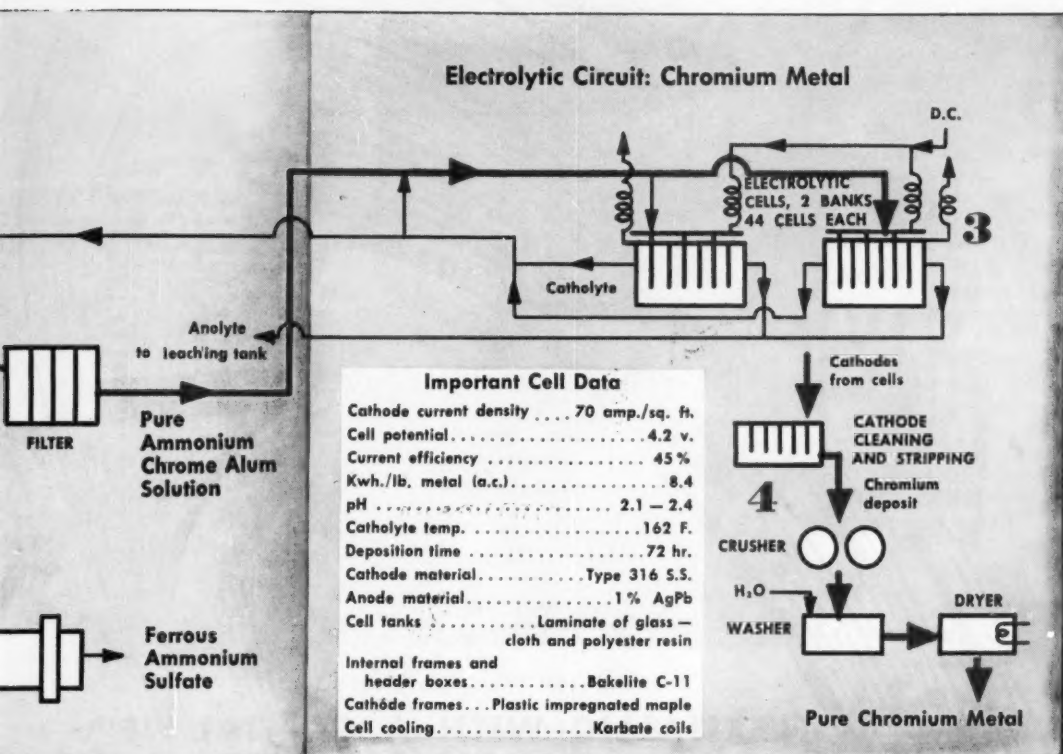
Chemical Circuit: From Raw Alloy to Pure Chrome Solution



2 HORIZONTAL FILTER separates violet chrome alum crystals ($\text{NH}_4\text{Cr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$) from mother liquor. These crystals make up cell feed.



3 CELL ROOM contains two banks of 44 cells (1-1/4-in. thick) on stainless steel cathodes on a



is each. Chromium deposits in a 72-hr. cycle.



4 METAL STRIPPING is accomplished with air hammers, after the cathodes have been washed. Stripped metal is crushed, washed and dried.



FLEXITALLIC WITH A CAPITAL "F"

The capital "F" in Flexitallic is for your protection. It designates the original Spiral-Wound Gasket made exclusively by this Company since 1912.

It represents the storehouse of gasket design experience used by Flexitallic engineers in providing exactly the right seal for your high-pressure, high-temperature sealing problem.

Designers and engineers responsible for confining fluids in extreme or hazardous service look to Flexitallic Gaskets for the high safety factor so essential in their calculations. It's why the capital "F" is so important in gasket specifications.

Each Flexitallic Gasket is designed and engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required

metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285".

FLEXITALLIC GASKET CO.
8th & Bailey Sts., Camden 1, N.J.

Representatives in principal cities

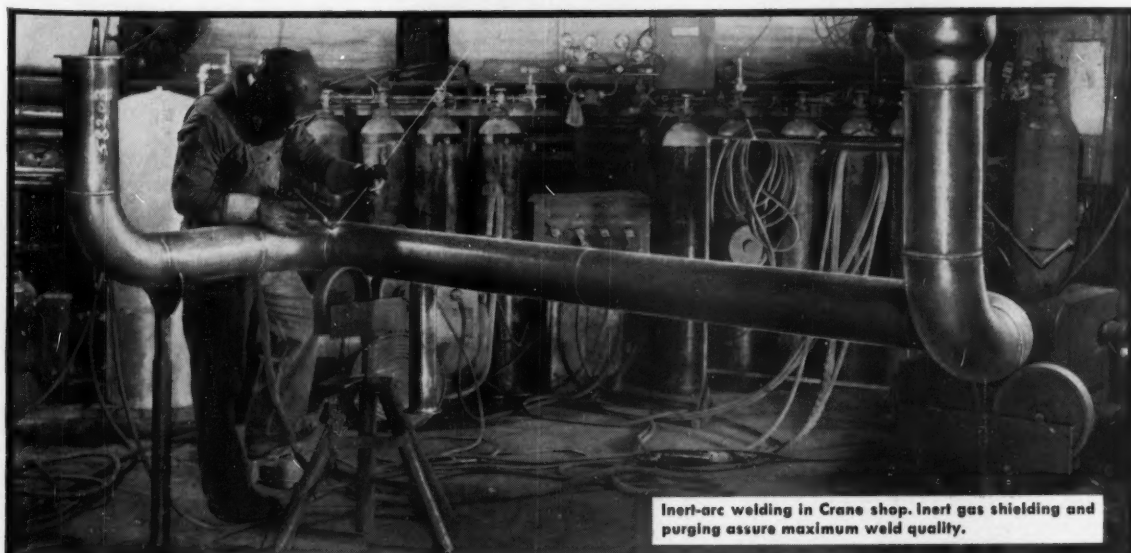
Flexitallic
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

**TEFLON FOR
PROCESS APPLICATIONS**

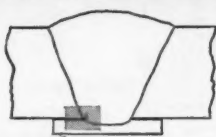
The ideal seal for many process applications is a Flexitallic Gasket with Teflon trapped between edges of stainless steel. Ask for folder, "Teflon in Flexitallic Gaskets."

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for Flexitallic Blue—it's our exclusive blue-dyed Canadian asbestos filler.



Inert-arc welding in Crane shop. Inert gas shielding and purging assure maximum weld quality.

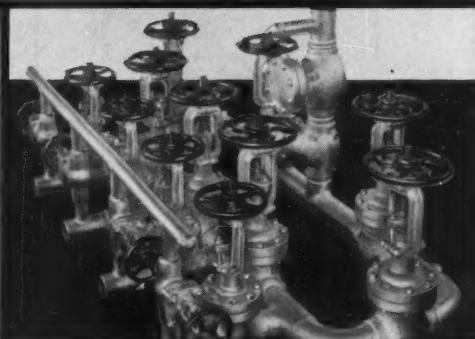
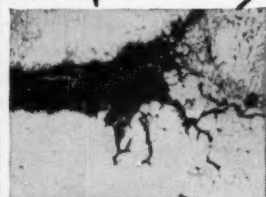
Root Crack in pipe joint made with backing ring and under external restraint



Remainder of weld can be by any suitable method



Crane inert-arc welded pipe joint, showing full penetration and fusion



Typical Crane unit fabrication—Loop header with 17 valves.

Crane-developed butt-welding technique assures more efficient process piping

Gives important advantages—eliminates backing rings

On shop fabricated assemblies, Crane inert-arc *first pass* welded butt joints are making significant contributions to modern process plant operation.

By eliminating backing rings as used with metal-arc welding, the Crane inert-arc first pass technique assures a high quality weld with smooth root contour without crevices and eliminates the possibility of basal cracks sometimes associ-

ated with backing rings or the characteristics of the base material.

The practicability and dependability of Crane inert-arc *first pass* welding have been thoroughly demonstrated. Leading process plants have been enjoying its advantages for several years. One installation involved many carloads of alloy fabrication in which all welds were inert-arc type.

Welding all types of stainless,

nickel, Monel, Hastelloy "B" and other alloy piping is just one of Crane's services to the process industries. Crane handles every phase of unit fabrication for manifolds, assemblies and valve groupings—simple or complex, large or small. Your local Crane Representative can give you valuable assistance on all your process piping needs—or, write Crane at the address given below. No obligation.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas



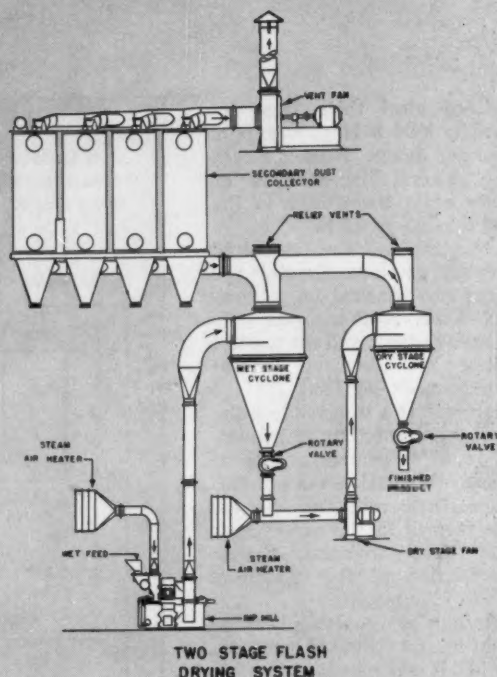
Another RAYMOND
Flash Drying **UNIT**



Raymond Imp Mill with Flash Drying Accessories and package furnace for removing moisture while pulverizing



Send for this new Catalog No. 82 if you are interested in other uses of Flash Drying



TWO STAGE FLASH DRYING SYSTEM

For handling STEARATE COMPOUNDS

Typical of the versatile applications of the Raymond Flash Drying System is the simplified production of various stearate materials in powdered form. There are many such installations in the chemical and process industries for the preparation of aluminum stearate, calcium stearate and zinc stearate.

These products come to the mill system in the form of filter-press cake or centrifuged materials, containing 50% to 70% initial moisture. They are rapidly processed through a two-stage Flash Drying Unit as shown in diagram above.

During the first stage, the moisture is brought down to about 5% and, in the final stage, it is reduced still further to one per cent or under. At the same time, the material is disintegrated in the Imp Mill to a finished fineness of all-passing-30-mesh, up to 99% or better through 325-mesh depending on the grade.

These stearates, as well as other heat-sensitive materials, are safely and economically handled by Flash Drying. Large air volume at high velocity . . . controlled temperature . . . and short time of exposure . . . are determining factors in preventing overheating or contamination of the product.

COMBUSTION ENGINEERING, INC.
Raymond Division

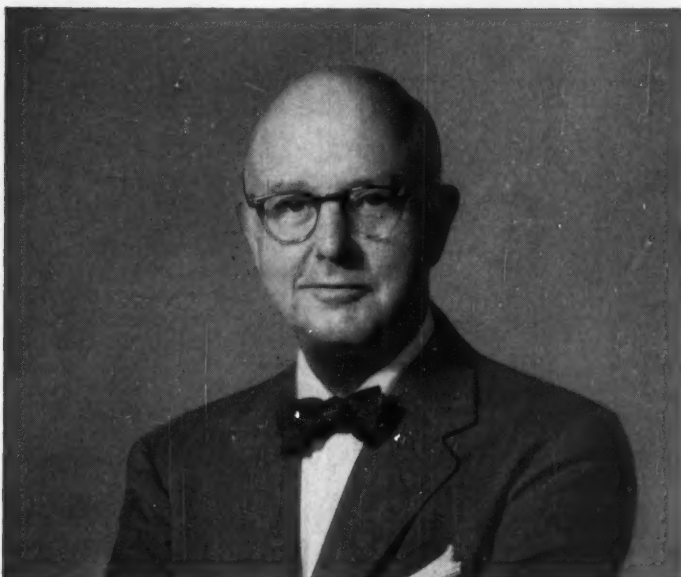
1311 NORTH BRANCH ST.
CHICAGO 22, ILLINOIS

Combustion Engineering-Superheater Ltd. Montreal, Canada

SALES OFFICES IN
PRINCIPAL CITIES

Names in the News

EDITED BY M. A. GIBBONS



The Arthur D. Little Presidency and the American Institute of Chemists Gold Medal; Dual Honors To . . .

Raymond S. Stevens: Man of the Month

"The 'long hairs' began talking to the 'hairy ears' and, before they knew it, things began to pop."

That's the way Raymond Stevens describes the birth of "Operations Research" in Washington during the war years. Risking a simplification, it stacked up like this: mathematicians and engineers teamed up, pooled ideas and came up with mighty accurate answers for so-called unsolvable problems.

Stevens saw that the scientific methods of Operations Research weren't inconsistent with those already used by Arthur D. Little and that they could be applied to industry. With OR, the Cambridge firm added a new dimension to its work by broadening the base of its research.

That's one of the reasons why Stevens became president of the company a few weeks ago and why the American Institute of Chemists will honor him, next

month, for his "contributions to the wider understanding of essential procedures for the management and operation of industrial research." (The AIC gold medal will be presented on May 10, in Boston.)

► **Let's Give It A Whirl**—It was Bruce Old—an ADL vice president—who really started Stevens on the "Opsearch" idea. Since then, Stevens has geared ADL into a wider variety of technical research. His projects run the gamut from the design of cryogenic equipment to the industrial development of West Virginia.

Queries aren't limited to technical details, either. The economic plausibility of every case, in terms of client's needs is his chief concern.

► **Human Hurdles**—"I don't care what you call it," Stevens says, "the key factor in Operations Research is the ability to bring together people of top intelligence, rigorously trained and brilliant

in their own fields—and to bring them together in the right combinations. The team means a lot more than the sum of individual talent."

But Stevens' interest doesn't stop with a careful selection of men; he likes to do well by his teams too. He enjoys helping them get some fun out of what they're doing: wants them to have the satisfaction of seeing the tangible results of their work as soon as possible.

That's why he hates time-consuming reports—as such. His job is to give the client a useful answer which will materialize into something workable. "What good do a lot of theories do on paper? In that stage, they haven't solved problems any more than they've boosted the morale of the men who've worked them out."

► **What Age Creativity?**—Stevens sees a lot of merit in the argument that the age of greatest creativity among research men rests with those between the ages of 25 and 35. Yet, he feels that the best research team must have a good mixture of youth with men of experience and proven judgment in the field.

During the earlier years, many authorities claim that the frequency of creative activity as related to quality of production is greatest. A bit later, however, comes the quantitative peak of turnout, and those valuable years when a man's seasoned judgment begins to show up.

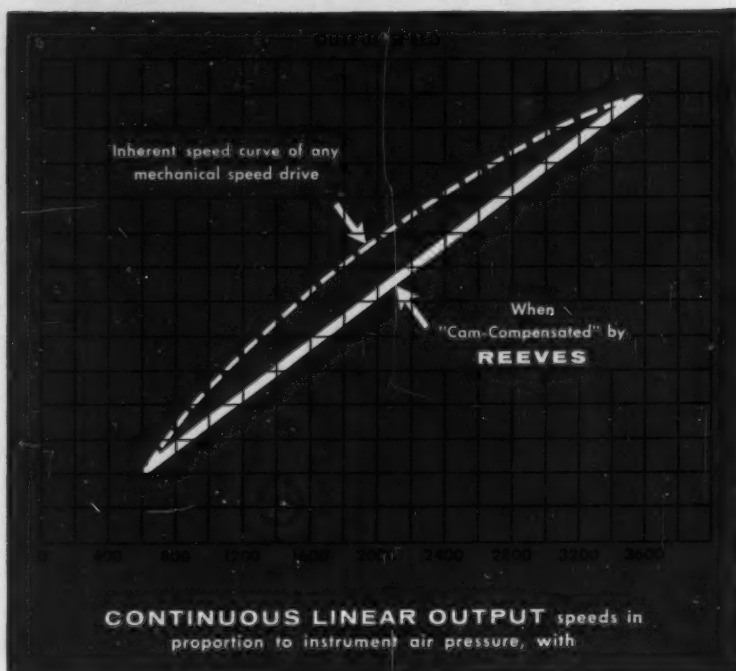
The two form a vital balance which determines the success of any research team.

► **Pet Project**—ADL's Industrial Bulletin owes much of its repute to Stevens' creativity. Since its outset—30 years ago—the four page bulletin has spread the word about industrial research and earned a tidy bit of respect for Arthur D. Little.

But, for Stevens, the Bulletin has been mainly, "a whale of a lot of fun: An excuse to dig in and find out about all sorts of things and to ferret out their long-range significance."

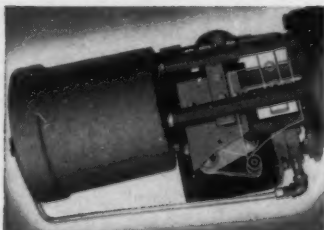
Officially the objective reads something like this: to look into

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NAMES . . .

the present status of industrial development or into the things which are indicative of its probable trend.

▶ **With a Second Chance** — Whenever Stevens thinks about what he might do if he had his life to live all over again, he says he would find more time to study people.

For this interest in people takes first place in his mind. Preferred reading matter is historical and biographical. At various times, he served with such groups as the planning board of the town of Melrose, Mass., and the Cambridge Chamber of Commerce. His interest in MIT has remained so great over the years, that it led to a tour of duty as president of the Alumni Association. Just now, he's moderator of the Unitarian Church in Cambridge.

And to top off the list, here's what his associates at the Woods Hole Oceanographic Institute have said of him: "Ray Stevens possesses amazingly broad interests in both basic and applied research; and an extraordinarily wide acquaintance with individuals and organizations in the field . . ." (Currently, Stevens is president of the Woods Hole organization.)

A. K. Doolittle has been appointed senior scientist in the research dept. of Carbide & Carbon Chemicals Co., to conduct research in liquid-state physics.

Stanley Tarailo, recent graduate of the University of Michigan, has joined the research & eng. division at Wyandotte Chemicals.

John W. James has been elected president of the American Society of Heating & Air-Conditioning Engineers.

Rush F. McCleary has been appointed general manager of the research and development dept., Jefferson Chemical Co., Inc.

Captain C. S. Seabring, USN, has been appointed director of research and development at Alco Products, Inc.



A. J. Brogini

The new executive vice president and chairman of the executive committee of Badger Manufacturing Co., Cambridge, Mass., engineering firm is A. J. Brogini.

Before joining Badger in 1952, Brogini was associated with the former E. B. Badger & Sons, Co., which he joined in 1937.

Brogini, 43, received his chemical engineering degree from the University of Michigan in 1934. He belongs to the AIChE as well as the American Petroleum Institute.

J. E. Lawson and J. W. Alliston have been promoted to senior chemical engineers at Humble Oil's technical service div.; **H. W. Earhart** is now senior research chemical engineer.

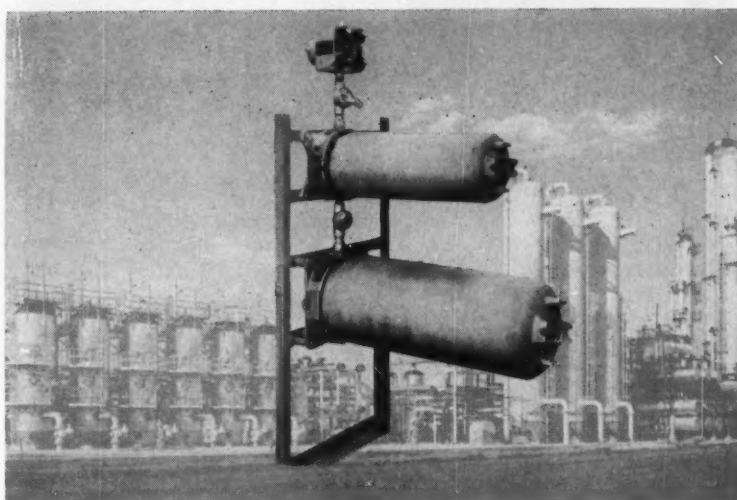
John E. Kasch and Charles F. Feuchter have been appointed by American Oil Co. as manager of coordination and manager of planning in the mfg. dept., respectively.

Walter Braunschweiger, executive vice president of the Bank of America, was elected vice chairman of the Air Pollution Foundation of Los Angeles.

Jack M. Rademacher, chemical engineer, has opened consulting offices in Bakersfield, Calif.

Dale F. Mason has been selected technical control manager of Rheem Automotive Co., chemical processing and metallurgical departments.

Robert E. Woodward, Morris Loeb professor of chemistry



The BICHROMATOR® Infrared Analyzer

Designed for Continuous Gas and Liquid Analysis Under Plant Conditions

Here is the first industrial infrared analyzer based on the proven principles of laboratory spectrometers and used for continuous monitoring and control of chemical processes. The Bichromator Analyzer is a two wave length, dispersion-type instrument, applying base-line density principles of the infrared laboratory to continuous process analysis.

It is an extremely stable and rugged instrument with no moving optical parts. The simple radiation null principle and closed loop servo system insure rapid response, virtual freedom from source or line current variation, or changes in amplifier linearity. This photometric system allows full-scale recorder operation with as little as 3% change in transmission.

The Bichromator Analyzer continuously measures the concentration of one component in an industrial sample. It is set on two wave length intervals; one, unique to the sample being analyzed (the component of interest), the other at a reference wave length where the sample does not absorb radiation. The energy difference at the two wave lengths is proportional to the concentration of the component of interest and can be converted to a measure of the concentration.

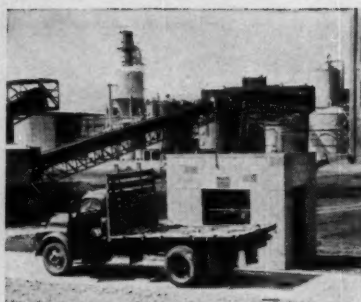
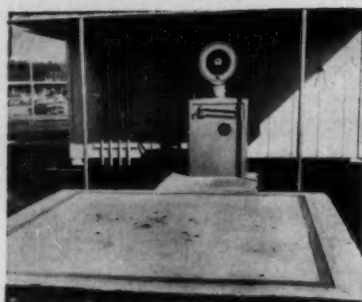
Thousands of laboratory infrared spectrometers now in use attest to the accuracy and stability inherent in the

design of the dispersion instrument. Furthermore, the performance of the Bichromator Analyzer *can be predicted* from laboratory spectrometer data and tied to present laboratory control procedures.

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- 1 Sample cell in separately purgeable compartment outside main instrument for ease of checking without exposing instrument proper to plant atmosphere.
- 2 Built-in test circuit for rapid, simple instrument checks in hazardous areas without need for tools or test equipment.
- 3 Electronics system features unitized construction with functional subassemblies for simplified servicing.
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- 8 Field conversion to a new problem is possible.

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NAMES . . .

at Harvard and consultant, has received the 1955 Research Corp. Award for Contribution to Science, in recognition of his work in synthesizing cortisone.

A. H. Hayes is the new senior asst. manager at Standard Oil's refinery at Whiting, Ind.; **F. H. Blunck** is manager of the unit operations div.; **L. H. Butterworth** will be asst. manager at Wood River, Ind.

George L. Foehringer, senior chemical engineer, has been named supr. of Staley Mfg. Co.'s monosodium glutamate plant.

J. T. Higgins, former president of Salt Lake Refining Co., is now general manager of operations in the mfg. dept. of Standard Oil Co. of Calif.

Paul D. Barton is now director of engineering and **George Closs** an associate director of engineering for Sun Oil, Philadelphia.

Robert F. Gager is the new vice president-research for Synco, Resins, Inc., Bethel, Conn. Prior to 1953, Gager had been chief chemist at Varcum Chemical Corp.

George L. Bond and **E. S. Rothrock** have been elected directors and vice presidents of Stauffer Chemical Co. Formerly, Bond had been president and Rothrock was executive vice president of Consolidated Chemical Industries, Inc.

J. Thomas Haigh has been appointed director of marketing for the Strong-Scott Mfg. Co., mfr. of equipment for milling and pulverizing.

George O. Morrison has been elected president of Gelvatex Coatings Corp., Anaheim, Calif.

R. Rea Jackson has been appointed general manager of the mfg. dept and chairman of the mfg. committee for Socony Mobil Oil Co.



G. A. Webb

Mellon Institute's new director of engineering is a specialist in chemical engineering economics and in organic chemical processing.

Dr. Webb gained much of his experience in coordination and planning during the past 13 years with Koppers Co.—where, in 1955, he became manager of the planning section (chemical div.).

He first joined the Mellon Institute, in 1937, on a fellowship relating to chlorinated rubber.

Ezra Bitcover and Robert Cree have been added to Foote Mineral Co.'s research and development laboratories, Berwyn, Pa.

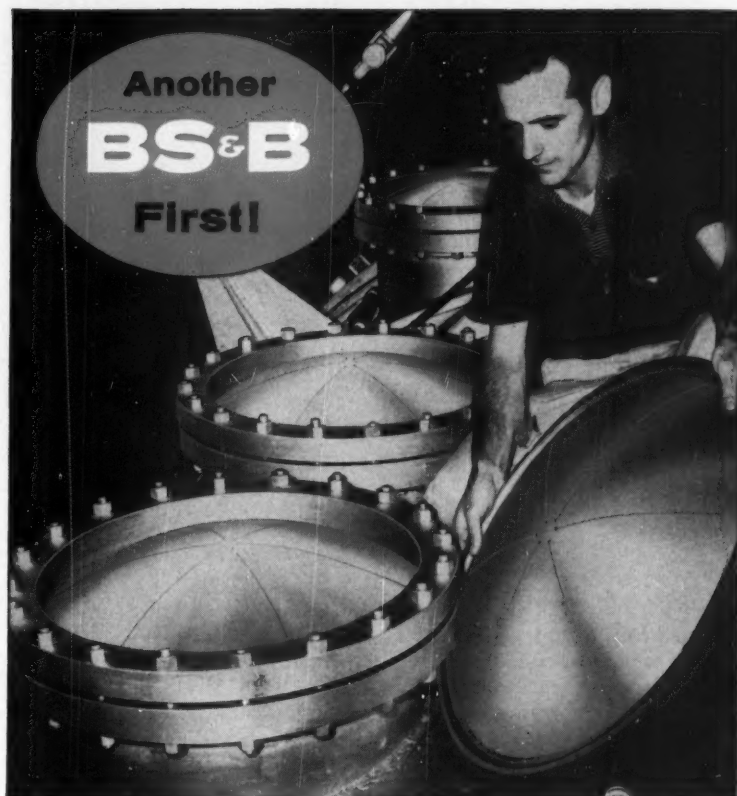
George E. McCullough has been named manager of process development for General Electric Co.'s chemical development dept., Pittsfield, Mass.

Martin A. Elliot, research professor at Illinois Institute of Technology, has been appointed director of the Institute of Gas Technology.

Milton Harris has been appointed director of research of The Gillette Co., Boston.

Leslie Schnurstein and Lawrence Hallahan have been named production superintendent and plant engineer, respectively, for the new chlorine-caustic soda plant of Hooker Chemical, Ltd.

J. H. Karchmer is the new research specialist and S. O. Brady is the new senior re-



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MICROMETER-ADJUSTED



REMOTE BULB TEMPERATURE CONTROL

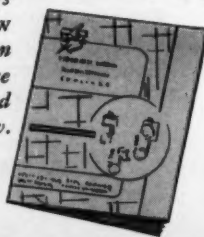
D5

TYPE
D5

UNITED ELECTRIC's Type D5 Remote Bulb Temperature Control is a precision unit containing a micrometer adjustment for obtaining wide ranges and accurate temperature settings. This control has found extensive use in applications such as laboratory and industrial ovens, water baths, hot plates, etc.

Temperature Ranges....	-150°F. to 200°F., 70°F. to 370°F., 100°F. to 650°F.
Switch Ratings.....	15 amps. at 115 or 230 volts A.C. Also 20 amps. or D.C. switches on specification.
Switch Types.....	N.O., N.C., or Double Throw — no neutral position.
On-Off Differential.....	Approximately 1.0°F. or 2.0°F. dependent on model.
Adjustment.....	Three-turn, calibrated knob rotated against graduated barrel. Readings and divisions equally spaced over entire range. Adjustment knob includes calibration screw.
Electrical Connections..	Made to internally located terminal block via clearance hole in the enclosure.
Capillary Tube Length...	Standard length six feet. Other lengths available.
Enclosure.....	Die-cast aluminum case with black wrinkle finish. Other finishes available.
Mounting.....	Control head surface mounted in any position by means of dog ears. May also be flush mounted.

Complete information on the Type D5 appears in Section 200 of UNITED ELECTRIC's new catalog. Section 200 contains detailed data on UE's complete line of remote bulb temperature controls. This information is clearly stated and attractively illustrated. Send for your copy now.



United Electric Controls
C O M P A N Y

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NAMES . . .

search chemical engineer at Humble Oil & Refining Co.'s research and development div., Baytown, Tex.

Bertram C. Raynes will head the dept. of chemical engineering at Horizons Inc., Cleveland. **James L. Wyatt**, formerly technical director, will head the metallurgical department.

John Lawrence is now president and chief executive officer at Joy Mfg. Co., Pittsburgh, Pa.

Donald H. Anderson has been appointed asst. supt. of the industrial laboratory at Kodak Park Works, Eastman Kodak Co.

Eugene Hiller is now general manager of research and production at Kinetic Dispersion Corp., Buffalo. **Donald Hazen** is the production manager.

R. F. Cole, chief engineer, Newport Industries, Inc., will take over the duties previously carried out by **Mr. Sisson**, Newport's new president.

A. I. Goldgerg and **O. B. Wurzburg, Jr.**, have been advanced to the posts of associate directors of research for the Nat'l Starch Products firm.

Samuel L. Nevins, vice president of Olin Mathieson Chemical Corp., has been awarded an Honorary Doctor of Laws degree by the University of Arkansas, for his achievements in chemical research and in industry.

Norman E. Hathaway has been appointed coordinator of marketing for Oronite Chemical Co. Before 1954, he had been director of the chemical and rubber div., Business & Defense Services Adm., Dept. of Commerce.

Charles Marsel of NYU has been elected president of the New York chapter of the American Rocket Society.

H. L. Anthony III is now a director of research for the Mellon Institute.



Donald L. Fuller

New director of research for Grace Chemical Research & Development Co. is the former technical director of American Cyanamid's New Orleans petrochemical plant.

Prior to 1952, Dr. Fuller had served for 10 years as associate director of General Aniline & Film's central research lab in Easton, Pa.

Fuller received his chemical engineering degree at the University of Minnesota where he also held a post-doctoral fellowship.

Ralph D. Patch, head of the petroleum products div. of Esso Standard's refinery in Baton Rouge, La., will serve as an advisor to the management of the Hamburg refinery of Esso A. G., in Germany.

Henry J. Ogorzaly has been named by Esso Research & Eng. Co. to follow the firm's nuclear activities affecting chemical and petroleum processes and products quality.

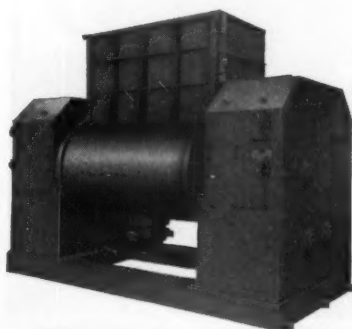
John P. Hyde, staff process engineer at Diamond Alkali's Cincinnati silicate plant, has been promoted to asst. mgr. of the Jersey City plant.

Walter J. Dugan has been appointed manager-sales development in the marketing section of GE's silicone products dept.

George A. Gentes has been appointed works manager and **Robert Sherwin**, plant engineer of the Tacoma, Wash., plant of Hooker Electrochemical Co., Niagara Falls, N. Y.



READCO'S IMPROVED MIXER DESIGN PROVIDES COMPLETE DISPERSION IN LESS TIME...FOR LESS COST



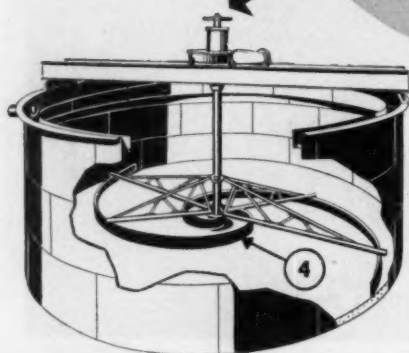
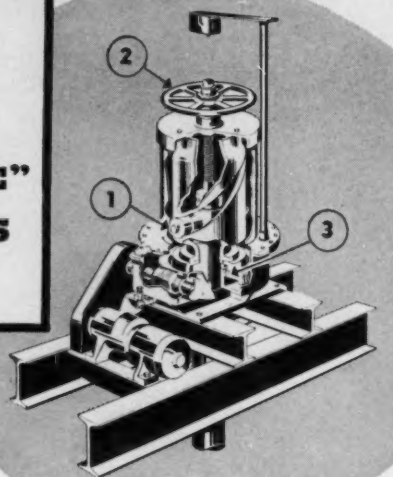
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3. Replaceable ring-type ball bearing support.
4. Spiral rakes.

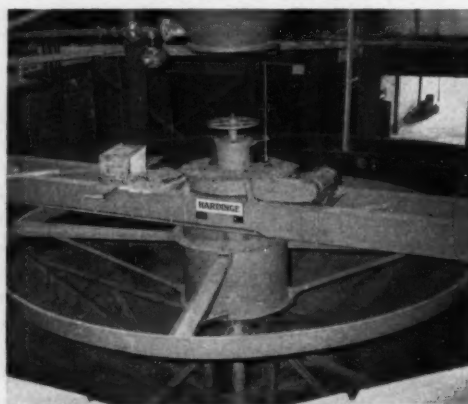
The higher the solids content in the thickener underflow, the lower the cost of filtering for subsequent processing or disposal.

The spiral rakes of the Hardinge Thickener compress the solids to maintain high density of underflow.

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NAMES . . .

John G. Dean, chemical and metallurgical consultant, Tuckahoe, N. Y., has been retained by Climax Molybdenum Co.

George V. Dupont has been promoted from manager of mfg. operations to general manager of Diamond Black Leaf Co.

Stuart T. Allen and Harold P. Stransky were promoted to assistant superintendents in the technical section at Du Pont's Charleston, W. Va., plant.

Kenneth H. Gayle, Jr., has been elected president of the Delta Tank Mfg. Co., Baton Rouge, La.

Frank Chrencik, works manager of Diamond Alkali's Deer Park plant in Houston, has been named general manager of the new electro chemicals div. During the war, Chrencik had been associated with the Army Chemical Warfare Service.

John E. Wood is now general manager of Esso Standard Oil's chemical products department. He succeeds O. V. Tracy, who will continue as a director of Esso and president of Enjay Co.

Charles A. Heiberger, research director of Food Machinery & Chemical's Ohio-Apex div. for the past 10 years, has been named manager of the plastics and polymers dept. in Princeton, New Jersey.

Hector D. Douglas, Jr., has been appointed district engineer for the lakes area, for Fansteel Metallurgical Corp., Chicago.

Donald L. Esmay and Ronald L. Larsen have joined the newly formed department of product research and development of Lithium Corp. of America, Inc., Minneapolis.

Joseph C. King has been named technical director of the southern div. of Metro-Atlantic, Inc.



William von Fischer

The former head of Case Institute's department of chemistry and chemical engineering, has been appointed coordinator of research and development for the Glidden Co., Cleveland.

After graduation from the University of Minnesota in 1937, Dr. von Fischer joined the Case faculty. There, a few years later, he set up a paint and varnish educational program which has continued to this date.

Von Fischer is a member of the AIChE and the ACS. He is the editor of "Paint and Varnish Technology" and co-editor of "Organic Protective Coatings."

Clayton Carter is the new plant manager of the new Murphy Corp. Michigan Chemical Corp. bromine plant now under construction at El Dorado, Ark.

Robert E. Lawrence and **J. Lloyd Mason** have joined Monsanto's technical services dept. at the Wm. Krummrich plant, in Ill.; **Salvadore P. Lio** is now sales manager for styrene molding materials for the plastics div. in Springfield, Mass.

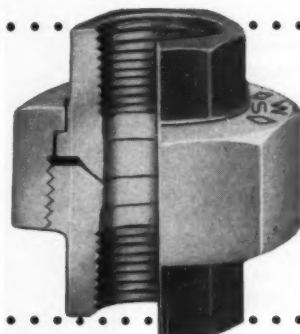
L. F. Davis has been appointed plant manager for Shawinigan Resins Corp.'s Trenton, Mich., facility. The new plant, for the production of polyvinyl butyral, will go on stream late this year.

Jess A. Meininger has been appointed manager of the newly formed milling industry technical service dept. at Victor Chemical Works, Chicago.

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These Features are
YOUR GUARANTEE of a Safe,
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W-S Forged Steel Unions give you the kind of protection you need in high pressure piping systems. They're designed with precision-machined spherical-to-angle mating surfaces for positive seating, free from leaks even when pipes are slightly out of line. Cadmium-plated nuts resist galling and seizing and forged steel construction gives you the extra strength you need in high pressure service.

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NAMES . . .

Henry H. Hausner has been named general manager of Penn-Texas Corp.'s nuclear engineering div. Hausner will also act as consultant for Westinghouse Electric's atomic power div.

Fritz J. Nagel is now vice president of Polymer Processes, Inc., Reading, Pa., to direct the development of the firm's new coating process: Whirl-clad.

Morehead Patterson has been appointed chairman of the American Standard Assn.'s planning committee for nuclear energy standards.

W. J. Butler, formerly asst. works manager at the Pasadena plant of Diamond Alkali Co., has been named general manager.

R. W. Booker & Associates, industrial processing and consulting engineers, has made the following appointments: **Carl Sandin**, chief, process section; **Clarence Palmer**, chief, design section.

George F. Klein, Jr. has been selected vice president in charge of engineering and a member of the board for Catalytic Construction Co., Philadelphia.

A. A. Nellis, technical supt. for Chemstrand's acrylic fiber plant at Decatur, Ala., has been elected chairman of the Tennessee Valley section of the AIChE for 1956.

Bert Cremers, vice president of Wyandotte Chemicals Corp. has been elected president and chairman of the board of the Chlorine Institute, Inc.

Charles R. Schroth has been appointed assistant manager and **Frank A. Magno** technical representative of the special blacks div., Godfrey L. Cabot, Inc.

Orville L. Fisher, general manager of Continental Oil's southern region since 1952, has been elected a vice president.



Max Tishler

Merck, Sharp & Dohme Research Laboratories has just named Dr. Max Tishler as vice president and executive director.

Tishler has worked with Merck for the past 20 years, holding such positions as senior chemist, director of developmental research and, most recently, vice president for the scientific activities of the chemical division.

A native of Boston, Tishler graduated from Tufts College and Harvard University. Before he joined Merck, in 1937, Tishler spent several years as a research associate and instructor, at Harvard.

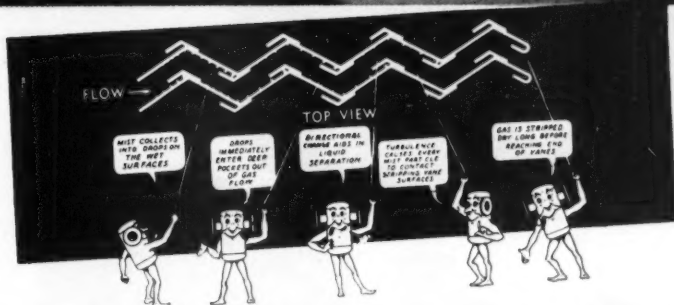
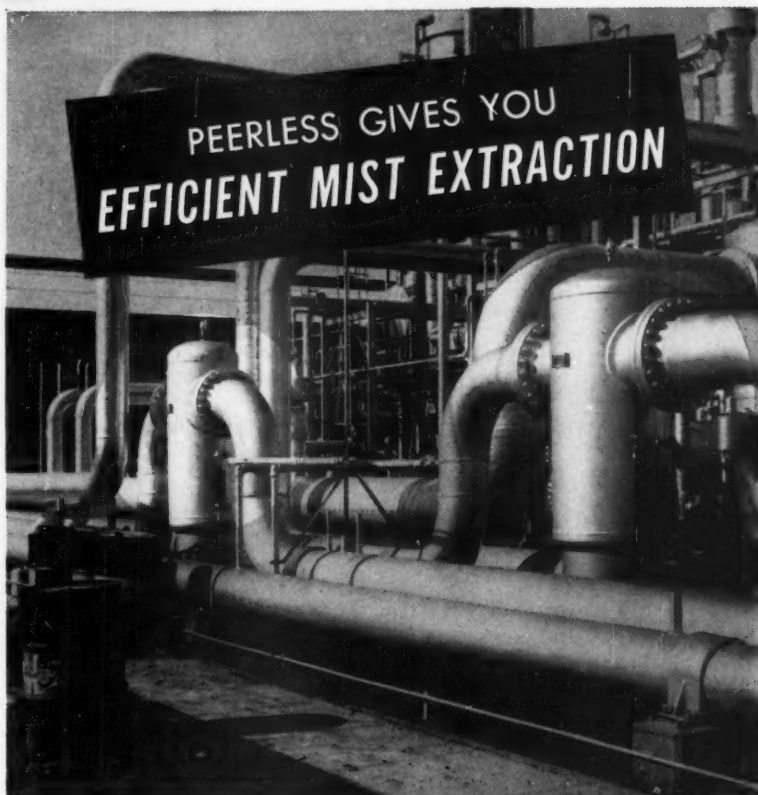
Lloyd W. Beck, John R. Schaeffer, Bruce H. Strain, W. R. Gowdy and Francis J. Coughlin have been appointed associate directors of Procter & Gamble's research & development dept.

Robert Burtner, Frank Colton, John Cusic and Ray Dodson, have been promoted to the newly created positions of asst. to the director of chemical research at G. D. Searle, & Co., Chicago.

OBITUARIES

James F. Thompson, vice president of Sterling Drug Inc., in charge of the Hilton-Davis Chemical Co. div., died January 18.

John Watson Teter, director of catalysis research for Sinclair Research Laboratories, Inc., died January 26, in Chicago.



The above photo is an example of one out of thousands of Peerless Line Separator installations in Refining and Chemical plants throughout the world. This installation is doing an effective job of mist extraction in a petrochemical plant in Kentucky.

In the above drawing, we have tried to give you an example of the Peerless principle of extracting Liquid mist from gas, steam or air. The Peerless Mist Extractor combines the forces of impingement centrifugal motion and surface tension to obtain its high efficiency. The path of the gas, etc., through the unit, is constantly bending, causing semi-violent turbulence and rolling of gas against the walls of the vane. Impingement and centrifugal force combine to contact the droplets with the vanes, where they coalesce, and surface tension then causes them to cling to the vanes' surface. Gravity and impact of the gas stream then drives the droplets into pockets where they roll down the vanes and out of the stream.

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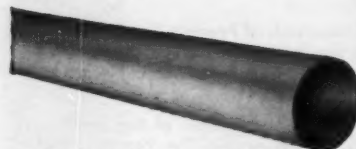
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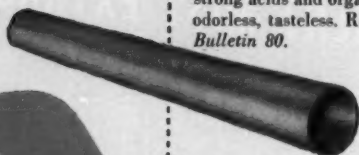


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AGE-PROOF

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ACE processing equipment of rubber and plastics

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Letters:



Rest in Peace

Sir:

Your November 1955 issue (pp. 106, 110) carried a terse, factual resume of the plans of Cosden Petroleum Co. to recover ethyl benzene from mixed xylenes by ultrafractionation.

In the interest of accuracy I wish to point out that the engineering and construction contractor for this plant is Badger Manufacturing Co., not "E. B. Badger" as your story stated.

Badger Manufacturing Co. is the successor to the manufacturing division of E. B. Badger & Sons, a company founded in 1841. In 1948 the rest of E. B. Badger & Sons was acquired by Stone & Webster Engineering Corp. as its Badger Process Div.

Corporately speaking, therefore, E. B. Badger & Sons no longer exists.

RICHARD V. REEVES
F. P. Walther Jr. & Associates
Wantagh, N. Y.

► Thanks to a sharp-eyed alumnus of CE's editorial staff for bringing this error to our attention.—ED.

Pro: Better English

Sir:

I am very much pleased at the tone of your review of Badger and Banchemo (Feb. 1956, pp. 312-4).

There was one point in your review, however, that disturbed me greatly, and that is the fact that you found places where you felt the English was complicated. This is exactly the thing that we hoped we had avoided, and under no circumstances do I wish the English to be such as

Pro & Con

C. H. CHILTON

to call for this type of criticism.

Please believe me that we feel you have done us a very great service in making this criticism, and we shall do our best to correct the questioned passages in the next printing.

W. L. BADGER
Consulting Chemical Engineer
Ann Arbor, Mich.

► *Maybe our standards of English are too high, as witness the comments in the following letter.*—ED.

Suits Seven Senior Students Sir:

The undersigned students, seniors in chemical engineering, have been surprised by your review of Badger and Banchero, since it is our regular textbook for the courses dealing in unit operations.

We are a Spanish-speaking country, and we have taken only the regular high school English courses in our studies; but it is a fact beyond question, and we all agree that we fully understand the English used by the authors in their book.

We find it plain, easy to understand and, what is more important, it has the merit of conveying a clear picture of the processes and apparatus.

ROGER BORI
GUILLERMO ALVAREZ
EDMUNDO FERRAND
AGNI PREVEZ
RAFAEL MELGOSA
ISIDRO PENDAS
R. SANTOS

University of Oriente
Santiago, Cuba

Pro: Technology Review

Sir:

I have just finished reading your feature report, "Technology in the Year Ahead" (Jan. 1956, pp. 175-190).

I'd like to tell you what a fine job I think it is. It is fascinating reading and manages to cover a tremendous amount of material without becoming tiresome.

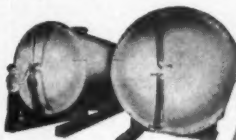
Like the Indian who was mak-

STAYS TOUGH AT SUB-ZERO TEMPERATURES

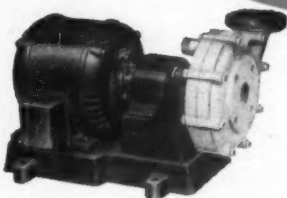
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P.w. of salvage, 100/
(1.08)² = -86
Total p.w., 2 yr. serv-
ice = \$2,355

New Pump

Present worth = \$3,800
P.w. of 5 yr. expenses,
(400) (4.312) = 1,725
Total p.w., 5 yr. serv-
ice = \$5,525

For equivalent uniform (end-
of-year) cost:

Old pump: \$2,355/1.783 = \$1,321
per yr.

New pump: \$5,525/3.99 = \$1,385
per yr.

Cost ratios for the new pump
vs. the old pump are:

Schweyer: \$1,350/1,262 = 1.07
Schweyer, corrected: \$1,385/1,321 = 1.05

Capitalized cost from Aug. 1955
article: \$17,200/16,510 =
1.05

Prof. Schweyer's calculation, when corrected to refer to the beginning of the year, gives the same ratio as my capitalized cost method. Prof. Schweyer can certainly refer annual expenses to the end of the year if he prefers it that way. Just because he prefers a different reference time than I do doesn't make the capitalized-cost method wrong.

I do take exception to the last paragraph of his letter, on these grounds:

• First, his results are not in exact agreement with mine because he has changed the reference time for yearly expenses. When he and I are on the same basis, the numbers give an exact mathematical check, as shown above.

• Secondly, the conclusion is *not* reversed. Even with his (incorrect) figures, Schweyer finds that the old pump is worth keeping for two more years. That was also the conclusion based on capitalized cost.

F. C. JELEN

Solvay Process Div.
Allied Chemical & Dye Corp.
Syracuse, N. Y.

Pro: Idea Selling

Sir:

The article, "How To Sell Your Next Idea" (Sept. 1955, pp. 220-4), should be in the hands of every young student of engineering in order to impress

upon him the importance of skillful report writing and convincing oral presentation of facts. You can render a real service to our coming generation of engineers by making the article available in reprint form.

ALFRED H. NADELMAN
Western Michigan College of
Education
Kalamazoo, Mich.

► Reprints are available; write our
Reprint Dept. for Prices.—Ed.

Blame W. 42nd St.

Sir:

Somewhere between Brandenburg and your printer in Albany, two errors found their way into my graph which you reproduced as Fig. 4 in the November 1955 Refresher (p. 220).

- The value of "Fraction converted, x " at the origin should be zero, not 0.1.

- One of the "Molar ratio" curves is incorrectly identified. It should be 1.1 rather than 1.2.

G. A. LESSELLS
Olin Mathieson Chemical Corp.
Brandenburg, Ky.

► While we're at it, let's correct another error which Mr. Lessells chose not to mention. Yep, we also misspelled his name!—Ed.

Pro: Engineers in Sales

Sir:

In a letter which you published last month (p. 307), Mr. Wilkins of Du Pont commented favorably on the contribution which technical people can make to the sales function.

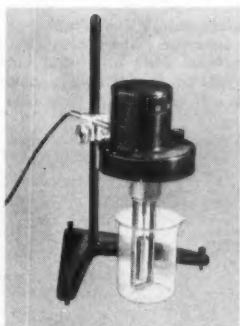
There may well be a rebuttal from those who look with alarm at the shortage of technically trained people for research and production jobs and then see able technical people doing market development and sales work.

We here at Dow Corning, at least, agree with Mr. Wilkins in feeling that the contribution the technical man can make in marketing can be as important—and in some cases more important—than the contribution he could make in his more traditional role.

A. WILLIAM RHODES
Dow Corning Corp.
Midland, Mich.



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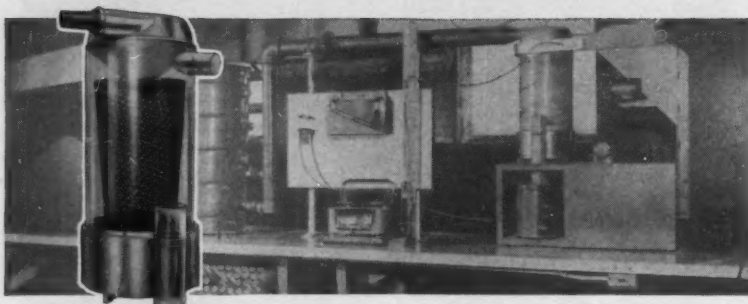


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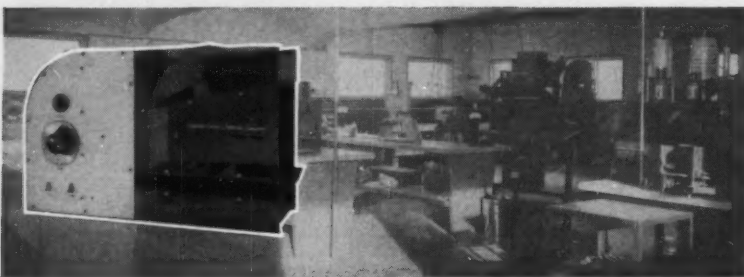
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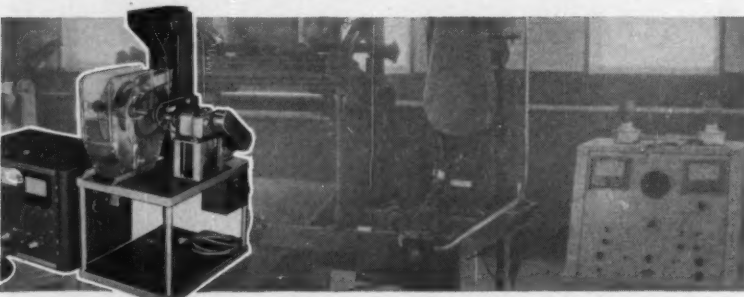
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ing smoke signals when he saw the smoke cloud from an atomic bomb explosion, "Wish I'd said that!"

DAVID E. PIERCE

Diamond Alkali Co.
Cleveland, Ohio

Con: Rote Calculations

Sir:

At the risk of compounding present confusion I must comment on the Lammers-Jelen article in your December 1955 issue (pp. 183-4) regarding theoretical economy calculations of annual costs. Some clarification is needed.

In comparing alternatives with different service lives and different annual expenses, the proper procedure is simple and straightforward. All irregular costs should be converted to present worth. Total present worth is then reconverted to equivalent annual costs (or a capitalized value of these annual costs).

For a worked out example, I'll use Jelen's original problem (Aug. 1955, p. 187):

"An improperly designed pump has an excessive power cost. Salvage value now is \$1,000, decreasing to \$250 next year and to \$100 the following year. Operating cost for one year more is \$700, and \$800 for the following year. A replacement costing \$3,800 will last 5 years with negligible salvage value. Its operating expense will be uniform at \$400 per year. If money is worth 8% should replacement be made now?

Computations by the present-worth method follow:

Old Pump

Present worth (p.w.)	=	\$1,000
P.w. of 1st year expense, 700/1.08	=	647
P.w. of 2nd year expense, 800/(1.08) ²	=	685
P.w. of salvage (a credit), 100/(1.08) ²	=	-86
Total p.w., 2 yr. service	=	\$2,246

New Pump

Present worth	=	\$3,800
P.w. of 5 yr. expenses, (400) (3.99)	=	1,596
Total p.w., 5 yr. service	=	\$5,396

For annual costs based on respective lives:

Old pump: $\$2,246/1.783 = \$1,262$ per yr.

New pump: $\$5,396/3.99 = \$1,350$ per yr.

Similarly, the capitalized values would be:

Old pump: $\$1,262/0.08 = \$15,800$

New pump: $\$1,350/0.08 = \$16,900$

The limitations (2 yr. service for old pump, 5 yr. for new) must be recognized by the user of such procedures.

I believe that these calculations are clearer than rote calculations by formulas and are in accord with published texts on theoretical economy. The factors used for the calculations may be found in such texts.

The results are in accord with neither Lammers nor Jelen for the same problem; in fact, the conclusion is reversed. The general problem of when to make the replacement is covered in standard texts. Jelen's independent approach has apparently confused the picture, as indicated by the numerous Pro and Con letters on the subject.

H. E. SCHWEYER
University of Florida
Gainesville, Fla.

► In the letter which follows, Dr. Jelen once more takes the stand in defense of his method of comparing the economics of alternatives.—ED.

Depends on Point of View

Sir:

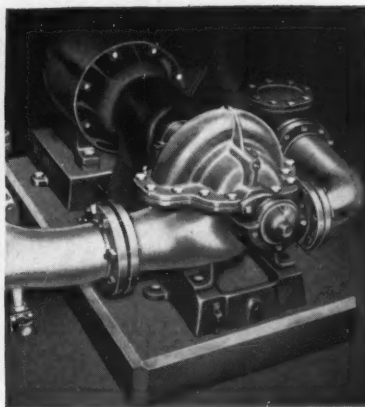
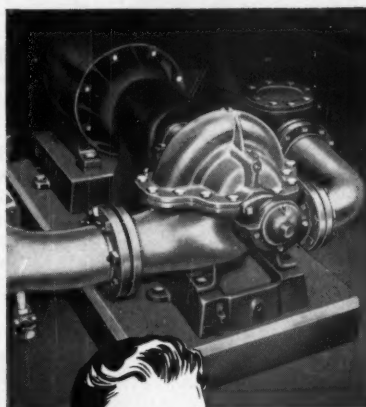
Prof. Schweyer has used some of the figures from my example incorrectly. Yearly costs in the example were referred to the *beginning* of the year. Prof. Schweyer uses them as if they referred to the *end* of the year. This has already been discussed in December 1955 Pro and Con (pp. 350-3).

Because the \$700, \$800 and \$400 annual costs refer to the beginning of the year, the correct tabulation is:

Old Pump

Present worth	=	\$1,000
P.w. of 1st year expense, $700/1.00$	=	700
P.w. of 2nd year expense, $800/1.08$	=	741

double protection



AGAINST COSTLY DOWNTIME

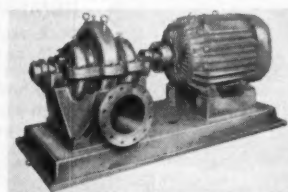
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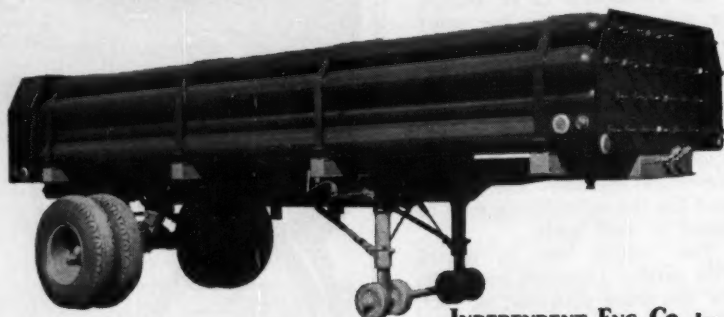


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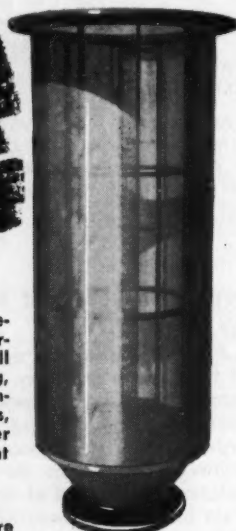
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Technical Bookshelf

EDITED BY R. K. GITLIN

Meets Our Expectations

CHEMICAL ENGINEERING. Unit Operations. Vol. II. By J. M. Coulson and J. F. Richardson. McGraw-Hill Book Co., New York. 975 pages. \$9.

It has been a little over a year since we reviewed the first volume of Coulson and Richardson. At that time these British authors impressed us with the quality of their engineering-science approach to the operations of chemical engineering.

In Vol. I, the authors restricted their discussion to the fundamental problems of fluid flow, heat transfer, momentum transfer and mass transfer. They promised to apply these fundamentals to the various unit operations and the design of commercial equipment when they got into Vol. II.

The promise has been well fulfilled. You'll be pleased with the results of their efforts. Even though both authors are professors and list no industrial experience in their pre-publication promotion pieces, Coulson and Richardson have managed to give Vol. II a practical engineering appearance.

Mainly, this achievement can be credited to the liberal use of white space on each page, excellent line drawings (and extensive use of same) and the insertion of photographs of commercial equipment. These illustrations are some of the finest that we have ever seen used to explain what goes on inside of chemical equipment.

Although this book covers the usual unit operations of chemical engineering, it arranges them according to certain fundamental similarities. This approach is becoming more and more popular. It is somewhat similar to that used in "Mass-Transfer Operations" by Treybal.

For example, Coulson and Richardson have grouped all the unit operations into these main categories:

- Flow of fluids past particles.

- Systems involving relative motion between a fluid and solid particles.

- Applications of mass transfer in chemical engineering.

- Applications of heat transfer (evaporation, crystallization and drying).

- Size reduction, classification and mixing.

It seems that there is now a trend away from the classical list of unit operations towards fewer but more logical groupings of similar operations. We feel that this progress is in the right direction.

A note of warning! This is a British book. It may—with proper teaching—prove satisfactory for use in undergraduate courses in the United States. However, as a reference work and for graduate students we think that Coulson and Richardson will make a place for itself in the American market.

On a dollar-per-page basis—which we'll admit is not the best way to evaluate a text—this volume is certainly competitive with other texts on unit operations.

If it is the duty of every book reviewer to find some fault with the book that he is commenting on, we comply: The authors duck their obligation in the area of reactor design by saying that it is their opinion that Hougen and Watson have adequately covered the subject in Vol. III of "Chemical Process Principles."

We couldn't disagree more. In the first place, Hougen and Watson is far from being the last word on the subject of reactor design. And the subject of reactor design is one that can no longer be left to the specialist or the graduate student. The chemical engineering senior should be thinking of reactor design problems when he considers the complicated interrelationships in processes where several fundamental unit operations are taking place at the same time.

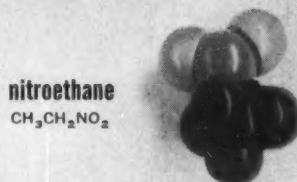
In a British review of this volume (*Chemical and Process*

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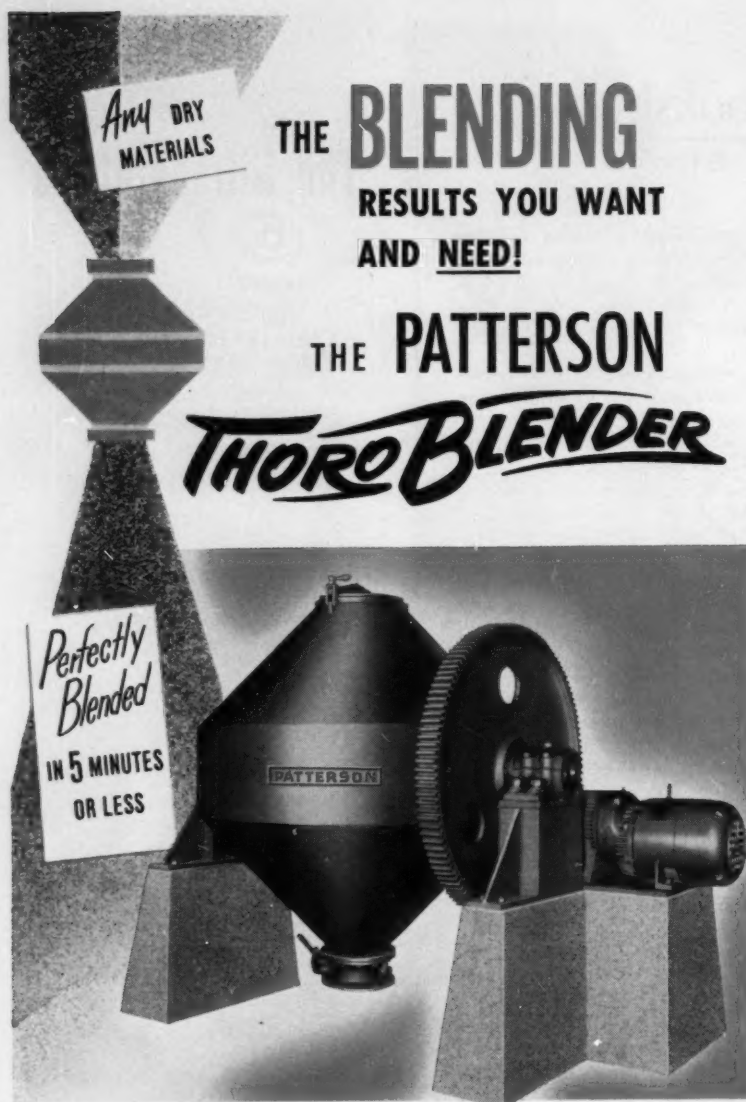
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MONTREAL

BOOKSHELF . . .

Engineering, Jan. 1956) we are told that the authors refuse to deal with subjects which are as yet purely empirical. This may be an admirable approach for the chemical engineering scientist. However, the students who go out into the wilds of industry must have some appreciation of empirical methods. This may—in time—prove to be another strike against this otherwise excellent work.—RFF

Worth Its Weight

DISTILLATION IN PRACTICE. Edited by C. H. Nielsen. Reinhold Publishing Corp., New York. 133 pages. \$3.

This little book is worth its weight (10 oz.) in gold (\$35 per oz.) in view of the priceless practical experience in distillation which it makes available to the novice. Authors of its six chapters have drawn on their years of experience with Du Pont, Stone & Webster, Sun Oil, Lummus, Hercules Powder and Atlantic Refining.

It's unique among books on distillation in that it makes no mention of relative volatilities, McCabe-Thiele diagrams or H.T.U.'s. Its emphasis, rather, is entirely on practical, non-academic aspects of the subject. Outstanding chapter, in this reviewer's opinion, is the one by Du Pont's Cy Pyle on "Over-All Tower Design from a Process Viewpoint."

Chief fault of the book is one often characterizing publications compiled from contributions of several authors—poor editing. Some material is repeated, some omitted. A photograph of a Turbogrid tray is shown on p. 14; the same photo appears again on p. 55. Graphs on pp. 12 and 15 have as their abscissas "Superficial F-Factor," yet the text makes no mention or identification of this term until p. 37.

Despite the book's attractive appearance, we wonder if the average chemical engineer wouldn't prefer a compilation of this scope (equivalent to six meeting papers) published in one-third the number of pages, using a magazine-size page. He could then file a relatively thin

pamphlet with his collection of related journal articles.—CHC

Automatic Process Controls

AUTOMATIC PROCESS CONTROL FOR CHEMICAL ENGINEERS. By N. H. Ceaglske. John Wiley & Sons, New York. 228 pages. \$6.75.

Dr. Ceaglske's book represents his best judgment of what automatic process control information is needed by chemical engineers. After teaching automatic control to chemical engineering students for 20 years—presently as professor of chemical engineering at the University of Minnesota—he has concluded that the courses generally given (largely descriptive) tend to retard progress.

Therefore, it's time for a change—from "hardware" to theory. In the author's opinion, automatic control for chemical engineers has now reached the stage that chemical engineering itself had reached in 1923 when instruction was suddenly systematized with the introduction of the first edition of Walker, Lewis and McAdams.

The book, though designed as an undergraduate text for other than electrical engineers, is also intended as an introduction to automatic control theory for practicing engineers whose prior knowledge is largely descriptive. It should be pointed out, however, that the title unduly limits the field of readership. There is little that limits it to the territory of the chemical engineer—or even the process engineer. It is, in fact, an interpretation of automatic control theory as it has been developing in the last 20 years among communications engineers and, more recently, those of the "servo-mechanisms school."

After a couple of initial chapters which deal very briefly with instruments, processes and control systems the book launches rapidly into that part of automatic control theory which concerns systems having linear response and no greater complexity than can be expressed by second-order differential equations.

The remaining chapters deal with the derivation of all the needed equations, the use of the

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Hazardous Jobs
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Help Management
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Breathe Easier**

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BOOKSHELF . . .

LaPlace transformation, solution of differential equations by standard methods and by inverse LaPlace transformation.

Analysis of transient disturbances is dealt with at length, as well as the frequency response of components and complete systems. The concluding section deals with the analysis and design of complete systems of simpler types.—TRO

Nuclear Fundamentals

NUCLEAR AND RADIOCHEMISTRY. By G. Friedlander and J. W. Kennedy. John Wiley and Sons, New York. 468 pages. \$7.50.

Reviewed by H. M. Clark.

This text is a revised version of "Introduction to Radiochemistry" (a presentation of nuclear science from the chemist's viewpoint) and an improvement on two scores—contains important new material, format and printing are better.

It's interesting to note that the new material reveals the extent to which the nuclear chemist's activities have broadened as new tools of producing and studying radioactive materials and new applications of nuclear phenomena (including nuclear power) have developed in the last five years.

The trend is also indicative of the direction in which the activities of the chemical engineer are increasing and will continue to increase as progress is made in developing nuclear power and finding ways of using nuclear radiation.

The following topics are indicative of the material covered in the thirteen chapters of the book: Fundamentals of radioactivity; properties of atomic nuclei; nuclear reactions—types, cross sections, production; target chemistry, including methods of radiochemical separation; mathematical relations for radioactive decay and growth, including equations for the transformation in a neutron flux; radioactive decay processes; interaction of ionizing radiation with matter; radiation chemistry; radiation protection; methods for detecting and measuring radiation; statistical aspects of

radioactivity measurements; radiochemical practices and techniques; chemical applications of tracers; nuclear energy—nuclear reactors and military applications; determination of the age of sources of radioactive materials; origin of the elements.

Included in the seven appendices are tables of physical constants and conversion factors, neutron cross sections, thick target yields, nuclear spins and nuclides. The table of nuclides is very useful, containing information on the percent abundance in nature, isotopic mass, half-life, decay modes and radiation energy for all known nuclides.

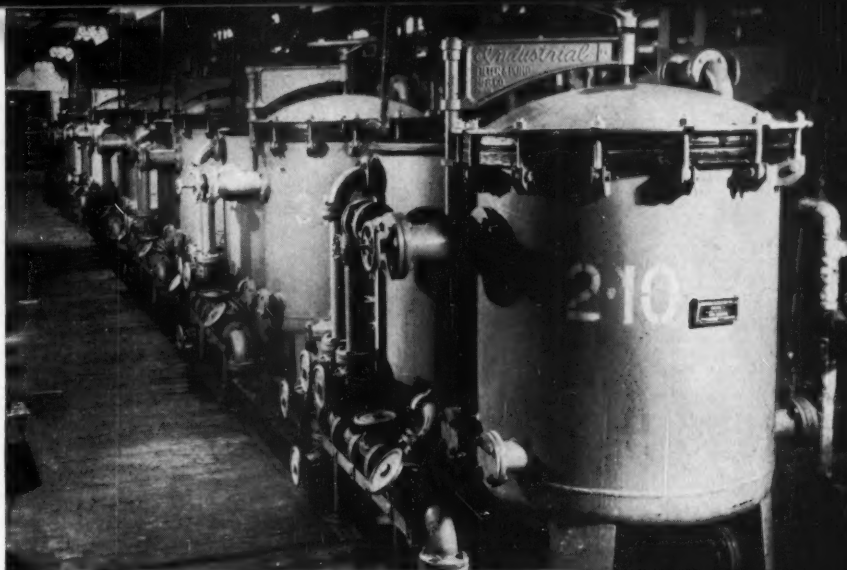
At the end of each chapter there are exercises and lists of key references. The latter are well suited to help the reader who may wish to study a topic in greater detail. Topics such as radiation chemistry and radiation protection are touched upon so lightly that most readers will feel the need for further reading. In the chapter dealing with theory of nuclear states and transformations, the nature of the materials covered is such that readers being exposed to the topic for the first time will certainly feel the need for supplementary reading.

On the whole, this volume is both an excellent textbook for graduate courses in nuclear and radiochemistry and a handy reference book. As a presentation of the fundamentals of nuclear science, it has a direct appeal to chemists and chemical engineers. But its utility is certainly not restricted to these two groups of readers.

Briefly Noted

SPECIFICATIONS AND TESTS FOR ELECTRODEPOSITED METALLIC COATINGS. (September, 1955). 96 pages. \$1.85. *American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.* Includes specs for zinc, cadmium, lead on steel; nickel-chromium on steel, on copper and on zinc; methods of preparation of various steels and alloys for electroplating; spray and thickness tests.

DISTILLATION LITERATURE—INDEX AND ABSTRACTS, 1953-54. 412 pages. \$12.50. *By A. Rose and E. Rose. Applied Science Laboratories, Inc., 140 N. Barnard*



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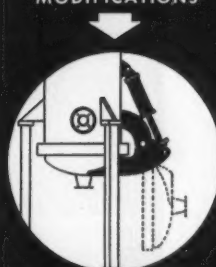
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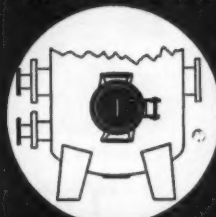
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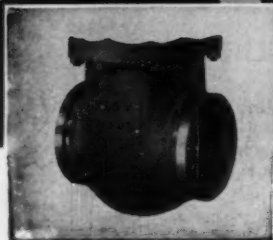
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BOOKSHELF . . .

St., State College, Pa. Third of a series started in 1941. Contains over 4,000 entries arranged by subject and author. Includes abstracts of journal and meeting papers, patents, books and book reviews, news items. New to this edition are sections on vacuum distillation of metals and vapor-liquid equilibrium data for thermodynamic correlation.

PULP AND PAPER MANUFACTURE—BIBLIOGRAPHY AND U. S. PATENTS, 1954. 521 pages. \$7. Compiled by J. Weiner. Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York, N. Y. Rather extensive listing of all phases of pulp and paper operations. Bibliography runs the gamut—from adhesives, air conditioning and ventilation, air pollution to white water, wood, wood transportation and wood waste. Patents cover chemistry of materials and equipment used in their processing.

STANDARDS OF THE HYDRAULIC INSTITUTE, 10th ed. 208 pages. \$4.75. Hydraulic Institute, 122 E. 42nd St., New York 17, N. Y. Handy loose-leaf binder containing six sections: general information about the institute, centrifugal pumps, rotary pumps, reciprocating pumps, data, index. Each of the pump sections—replete with schematics, tables and graphs—is subdivided into class; type; nomenclature; general information; designation by materials; application standards; rating standards; test codes; instructions for installation, operation and maintenance.

TABLES OF THERMAL PROPERTIES OF GASES. 488 pages. \$3.75. By J. Hilsenrath, et al. National Bureau of Standards Circular 564. Government Printing Office, Washington 25, D. C. Covers air, argon, carbon dioxide, carbon monoxide, hydrogen, nitrogen, oxygen and steam. Tables are given at close-temperature intervals for thermodynamic and transport properties. Thermodynamic properties are tabulated for real gas at pressures to 100 atm. and temperatures of 600 K. (H_2), 1,500 K. (CO_2), 850 K. (steam), 3,000 K. (rest). Ideal-gas thermo functions are tabulated uniformly to 5,000 K.

ASTM SPECIFICATION FOR STEEL PIPING MATERIALS. 425 pages. \$4. American Society for Testing Materials, 1916 Race St.,

Philadelphia 3, Pa. Latest approved form of 58 ASTM specs for ferrous pipe, tubes, castings, fittings, bolting materials. Contains 47 revised standards and 4 not included in the 1954 issue.

BIBLIOGRAPHICAL ABSTRACTS ON EVALUATION OF BRIGHTENING AGENTS FOR DETERGENT USAGE. 9 pages. \$1.50. Prepared by L. E. Weeks. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Covers 37 references from 1943 to 1955, listing them by year, author, journal. Some abstracts cover evaluation of paper brighteners.

More New Books

ADVANCED ANALYTICAL CHEMISTRY. By W. Wagner, C. J. Hull and G. E. Markle. Reinhold. \$6.

ANALYSIS OF MINERALS AND ORES OF THE RARE METALS. 3rd ed., revised. By W. R. Schoeller and A. R. Powell. Hafner. \$9.75.

FLUID FLOW IN PRACTICE. Edited by J. R. Caddell. Reinhold. \$3.

FLUIDIZATION. Edited by D. F. Othmer. Reinhold. \$7.

FUEL—SOLID, LIQUID AND GASEOUS. 5th ed., revised. By J. S. S. Brame and J. G. King. St. Martin's Press. \$10.

GENERAL ASPECTS OF THE USE OF RADIOACTIVE ISOTOPES: DOSIMETRY. Peaceful Uses of Atomic Energy, Vol. 14. Columbia University Press. \$6.50.

MATHEMATICS OF PHYSICS AND CHEMISTRY. By H. Margenau and G. M. Murphy. Van Nostrand. \$7.95.

ORGANIC SYNTHESIS. Vol. 35. Edited by T. L. Cairns. Wiley. \$3.75.

PHYSICAL ORGANIC CHEMISTRY. By J. Hine. McGraw-Hill. \$9.

PLASTICS PROGRESS 1955. Edited by P. Morgan. Philosophical Library. \$17.50.

PRINCIPLES OF CHEMICAL ENGINEERING THERMODYNAMICS. By E. D. Wilson and H. C. Ries. McGraw-Hill. \$7.50.

PRINCIPLES OF ORGANIC CHEMISTRY. By J. English, Jr. and H. G. Cassidy. McGraw-Hill. \$6.50.

PROFESSIONAL ENGINEER'S EXAMINATION—QUESTIONS & ANSWERS. By W. S. La Londe, Jr. McGraw-Hill. \$6.50.

STEELS FOR THE USER. 3rd ed. By R. T. Rolfe. Philosophical Library. \$10.

TITANIUM. Metallurgy of the Rarer Metals, No. 4. By A. D. McQuillan and M. K. McQuillan. Academic Press. \$10.

THERMAL POWER FROM NUCLEAR REACTORS. By A. S. Thompson and O. E. Rodgers. Wiley. \$7.25.



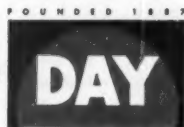
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Mexico: T. de la Pena e Hijos, S.A., Nazas 45-A, Mexico 5—D.F.

Xtracts

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DU PONT
ELECTROCHEMICALS DEPARTMENT

Sodium Dispersions Spark Many Reactions Once Thought Impractical

Sodium dispersions—a Du Pont development which quickly caught on to become a familiar tool in many parts of the industry—are used in a number of important reactions, many of which were impractical before the technique was discovered. Here is a brief rundown of some of the prin-



cipal types in case you have a similar problem and haven't tried sodium dispersions as a possible solution yet:

REDUCTION . . . Esters to alcohols . . . nitriles to amines . . . fatty esters to keto alcohols and acyloins . . . and aromatic hydrocarbons such as naphthalene to 1,4 dihydronaphthalene.

REFINING HYDROCARBONS . . . Inert hydrocarbons such as naphthalene can be refined with less than 1% by

weight sodium. Use of sodium dispersions reduces cycle to minutes with little or no agitation.

CLAISEN CONDENSATION . . . Sodium dispersions produce striking results in Claisen condensations such as the preparation of aceto acetic ester by self-condensation of ethyl acetate.

PREPARING ALCOHOL-FREE ALKOXIDES . . . Sodium alkoxide solutions or slurries can be readily prepared by treating sodium with an excess of alcohol.

HALIDE CONDENSATION . . . Sodium can be used in the condensation of alkyl or aryl halide, such as in the preparation of decane from amyl chloride.

POLYMERIZATION CATALYST . . . Sodium is useful as an active catalyst in many polymerization reactions, including the preparation of butadiene-type synthetic rubbers.

To help you take advantage of the versatility of sodium dispersions in your own laboratory or manufacturing process, Du Pont has prepared an informative booklet telling you how to make and use them. For your copy, simply fill in the coupon.

Tough Greaseproof Protection for Paper from "Elvanol" Polyvinyl Alcohol

Tough, flexible films that find many uses on paper products can be produced from solutions of "Elvanol" polyvinyl alcohol. "Slush-coating" of fiber drums, for example, produces a rugged, greaseproof coating ideal for the packaging of oily or greasy materials.



Completely hydrolyzed grades of "Elvanol" form excellent greaseproof coatings for packaging nuts, doughnuts, cookies, etc. Durable coatings are easily applied, provide a protective barrier against air—so important in food wrapping—and take customary folds,

creases and hard wear without cracking.

These are just a few of the many jobs "Elvanol" can do. For more ideas on how it can be put to work for you, simply fill out and mail the coupon below today.

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- ☐ Epoxides
- ☐ Elvanol® polyvinyl alcohol
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The highly reactive nature of the epoxide ring, together with recent developments in the *in situ* epoxidation of natural fats and oils, have combined to give hydrogen peroxide a promising role in the production of a growing list of new intermediates and industrial chemicals from these plentiful raw materials.

For example, among the possible uses for epoxides, or for epoxides further modified with other chemicals, can be cited: plasticizers for polyvinyl chloride, stabilizers for chlorinated rubber, synthetic drying oil compositions, resins and resin coatings (resulting from cross-linking or curing via epoxy groups), synthetic lubricants and lubricating oil additives, detergents and other surface active compounds, synthetic waxes, emulsifiers and modifying agents,



and the manufacture of certain insecticidal compounds.

Epoxides have also shown promise in pharmaceuticals, steroids, as solvents, fireproofing impregnants, sulfite esters, rubber-like materials, cytotoxic agents, and in compounds for preventing fermentation and mold formation.

THF—A Versatile Intermediate and Powerful Solvent



Tetrahydrofuran—probably best known as a powerful solvent for polyvinyl chlorides and other hard-to-dissolve plastic materials—also has many promising possibilities as a chemical intermediate.

Tetrahydrofuran undergoes a wide variety of reactions, generally with ring fission. Some typical reactions are: oxidation to succinic acid; chlorination to yield 2, 3-dichlorotetrahydrofuran; hydrochlorination to yield 4-chlorobutanol; and acylation to yield esters of 1, 4-butanediol.

Of further interest to the chemist is the fact that THF is useful in extraction and as a solvent medium, particularly for Grignard, sodium acetylide and other reduction reactions. Its ether structure, stability, and low boiling point, together with its high solvent power make THF of real value in both fields.

Prompt shipments of Tetrahydrofuran are now available in tank car and drum quantities from Niagara Falls, New York.

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THIS MONTH'S

Firms in the News

EDITED BY F. ARNE

New Names

Brighton Copper Works, Inc., Cincinnati, has changed its name to Brighton Corp. because its fabrication work for the chemical process industries is no longer confined to copper but includes the range of currently-used metals.

New Representatives

Olin Mathieson Chemical Corp. has named Ramset Fastening System, Cleveland, as sales agent for its Western Kiln Gun which is used by the cement industry to remove clinker rings in rotary kilns.

Stauffer Chemical Co. has signed a long-term exclusive sales agreement with Wilson & Geo. Meyer & Co. under which the latter will widen its western and midwestern distribution to handle increased production of new pelletized agricultural phosphates produced by Stauffer.

Hammel-Dahl Co., Providence, R. I., manufacturers of automatic control equipment, has appointed the E. B. Miller Co., St. Louis, as its sales representative in that territory.

Horizons Inc., Cleveland, has been awarded two new government contracts for work in the fields of barium titanate and titanium hydride formation. The first contract is with Wright Air development Center, the second with the Office of Naval Research.

New Companies

Cleaver-Brooks Western Hemisphere Ltd. has been established to expedite marketing of products such as boilers, evaporators and distillation equipment made by Cleaver-Brooks Co., Milwaukee.

Ascot Chemical & Adhesive

Corp. has been formed to make plain and pressure-sensitive transparent tape in the Metropolitan New York area. It is a subsidiary of E. S. & A. Robinson Ltd., Bristol, England.

F. J. Stokes Co. of Canada, Ltd. has been established as a subsidiary of F. J. Stokes Machine Co., Philadelphia, to carry on the latter's growing Canadian operations.

Asco Products Corp. has been formed by Asphaltic Specialties Co., Nixon, N. J., to handle its marketing and sales.

Freeport Oil Co. has been established as a division of Freeport Sulphur Co. to diversify its interests and acquire reserves of oil and gas.

National Chemical Credit Assn., consisting of 76 of the nation's chemical companies, has been formed by a merger of the Drug, Cosmetic and Chemical Credit Mens Assn., New York, and the National Chemical Credit Assn. of Cleveland.

Infilco Inc., Tucson, Ariz., designers and manufacturers of equipment for water treatment, has formed an Australian subsidiary with offices in Sydney.

Resources Research, Inc., Washington, D. C., a firm of consultants specializing in solving air and stream pollution problems has been formed.

Cicero Corp. of Colorado, a general engineering firm, has been formed to obtain chemical plant construction contracts in the southern Colorado area.

New Lines

Kaiser Aluminum & Chemical Corp. is entering the alumi-

LEE

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PROCESSING EQUIPMENT

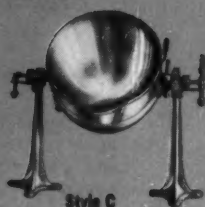
PRECISION BUILT OF **STAINLESS STEEL**
TO YOUR SPECIFIC REQUIREMENTS



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5 to 500 gal.



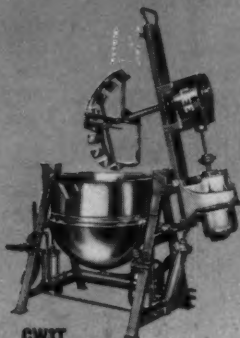
Style B
Full Jacketed
10 to 300 gal.



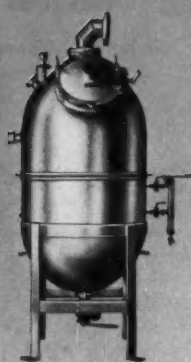
Style C
Two-thirds Jacketed
5 to 100 gal.



Pressure Kettle
Two-thirds Jacketed
40 to 200 gal.



CW3T
Center-line Scraper
Agitator Kettle—80 to 300 gal.



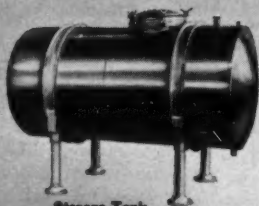
Vacuum Pan
50 to 500 gal.



Style CW
Two-thirds Jacketed
80 to 300 gal.



Pulp Tank
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Storage Tank
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Quick Cooling Pan
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FIRMS...

num food container business with two plants. One, costing over \$1 million, is under construction at Wanatah, Ind. The other has been acquired through purchase of Foil Kraft, Inc., Los Angeles producer of aluminum containers for the frozen food industry.

Dorr-Oliver, Inc., has acquired a line of centrifuges, centrifugal screens and strainers through the acquisition of Merco Centrifugal Co.

International Salt Co., Scranton, Pa., can now supply rock salt and evaporated salt dissolvers, and brine storage tanks, all made of polyester glass-reinforced plastics.

St. Regis Paper Co. has acquired a line of glassine and grease-proof paper and supercalendered sulfite paper through the purchase of Rhinelander Paper Co., Rhinelander, Wis.

Borg-Warner Corp. now has a complete line of worm gear speed reducers through the acquisition of Eberhart-Denver Co. of Denver.

New Locations

Acheson Dispersed Pigments Co., a unit of Acheson Industries, Inc., has moved to the Morris Bldg., Philadelphia.

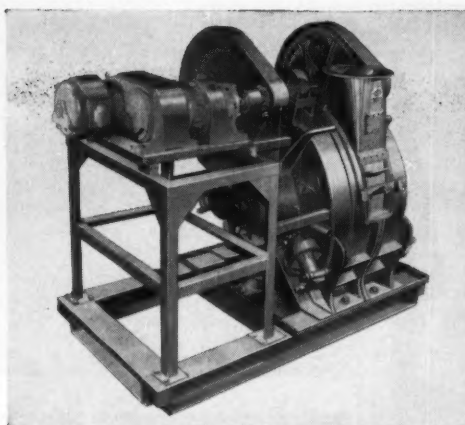
McKesson & Robbins, Inc. has moved its northeastern district office and the New York branch office of its chemical department to 225 Fourth Ave., New York. The Philadelphia branch office has been moved to 225 South Broad St.

Selas Corp. of America has moved plant and offices to Dreshertown, Pa.

Ralph Stone and Co., consulting engineers, has moved to 147 San Vicente Blvd., Beverly Hills, Calif.

Frontier Chemical Co., Wichita, Kan., has moved its offices to the Wichita Municipal Airport Terminal Bldg.

Shell Chemical Corp. has moved



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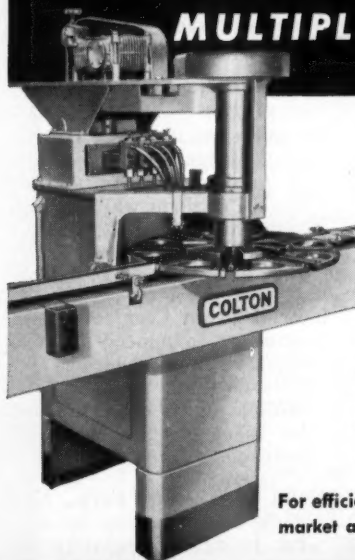
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WORLD'S FASTEST, MOST ACCURATE, MOST VERSATILE MULTIPLE LIQUID FILLER

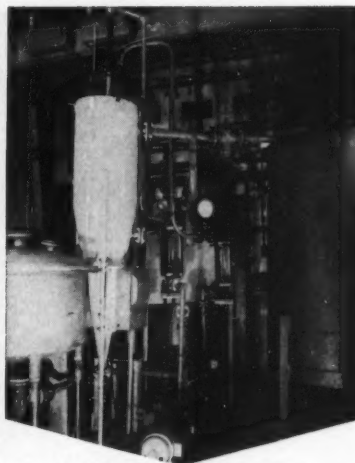


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Polyvinyl chloride processing tank (above) and flanged pipe and valves (below) in small pilot plant laboratory.



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Chemlon Yarn Style C-30 extra tough packing gives you two important advantages not provided by other types of braided or molded Teflon packing: 1) positive sealing efficiency at high peripheral speeds; 2) cooler running stuffing box under severe service conditions.

Style C-30 can be used to handle the most destructive acids, alkalis or solvents. The excellent thermal properties of Teflon, combined with the softness, resiliency and fluid retentive properties of fine fiber construction, adapt it to high temperature conditions to +300°F. The packing is made firm and dense by means of a special process which eliminates large voids.

HERE'S PERFORMANCE PROOF:—Fluid handled: 45% H₂SO₄ (impure) at 170°F.—Operating conditions: 1¼" pump shaft at 1700 rpm. or 555 fpm. peripheral speed. Results: 46 days good service. Previous best service record 7 to 10 days.

Chemlon Yarn Packing Style C-30 is available in spool or coil form, in a wide range of sizes from ¼" up. Can be lubricated with Teflon suspensoid or various types of lubricants.

Send for Bulletin No. P-321. Crane Packing Co., 6451 Oakton Street, Morton Grove, Illinois (Chicago Suburb), Hamilton, Ont.

*DuPont Trademark



OFFICES IN ALL PRINCIPAL CITIES

FIRMS . . .

the office of the recently-consolidated Delta-Houston district of its agricultural chemical sales division to 119 South Claiborne, New Orleans.

Witco Chemical Co. has moved its San Francisco district office to 80 Stonestown.

New Facilities

Honeymead Products Co. is building a 360,000 lb./day vegetable oil refinery at its soybean plant in Mankato, Minn., for various grades of technical, edible, margarine and shortening oils.

Standard-Vacuum Oil Co. plans a \$20-million modernization project for its Sungei Gerong refinery in Indonesia which includes addition of a fluid catalytic cracking plant and a catalytic polymerization unit.

Southern Oxygen Co., Bladensburg, Md., plans a \$1.25-million project for added facilities including acetylene and hydrogen plants.

E. I. du Pont de Nemours & Co. has started up a new Niagara Falls, N. Y., unit which will double production of its Elvanol polyvinyl alcohol.

American Viscose Corp. plans to expand its annual cellophane capacity by 50 million lb. Additional poundage will be produced at its Marcus Hook, Pa., plant which manufactured rayon textile yarns until it discontinued commercial operations in 1954.

Interlake Iron Corp. of Cleveland has announced plans to expand and modernize its Chicago plant by some \$15.9 million, much of which will be spent on 100 new coke ovens.

Metal & Thermit Corp., New York, is increasing by 35% its productive capacity for high quality zirconium silicate glaze opacifiers. The company has also recently combined Canadian activities with United Chromium of



A Book You Should Have on Mechanical Sealing...

A complete reference catalog on Dura Seal—the engineered mechanical seal that rotates with the shaft. Amply illustrated . . . specific applications . . . installation data. A fact book of real value to designers, operators and maintenance departments.



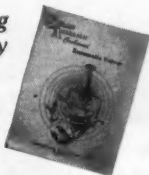
**WRITE FOR DURA SEAL CATALOG NO. 455-CE
DURAMETALLIC CORPORATION
KALAMAZOO, MICHIGAN**

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Golden-Anderson has never sacrificed quality just to "close the order." For over 50 years we have been designing and manufacturing valves that give dependable operation . . . that need little maintenance . . . that last a lifetime.

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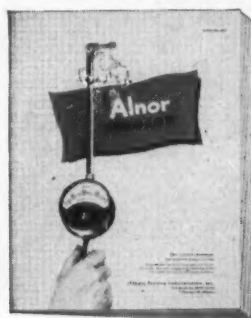
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FIRMS . . .

Canada, Ltd., under the name of Metal & Thermit-United Chromium of Canada, Ltd.

Monsanto Chemical Co.'s chemical melamine facilities at Everett, Mass., are being consolidated and modified to permit further manufacturing efficiencies and increased production. The company has also started building a multi-million administration and research center at Creve Coeur, Mo.

Davison Chemical Co., division of W. R. Grace, has completed \$300,000 worth of new facilities at its Perry, Md., fertilizer plant which will increase capacity by 50%. The company has also started construction of a research laboratory in Howard County, Md.

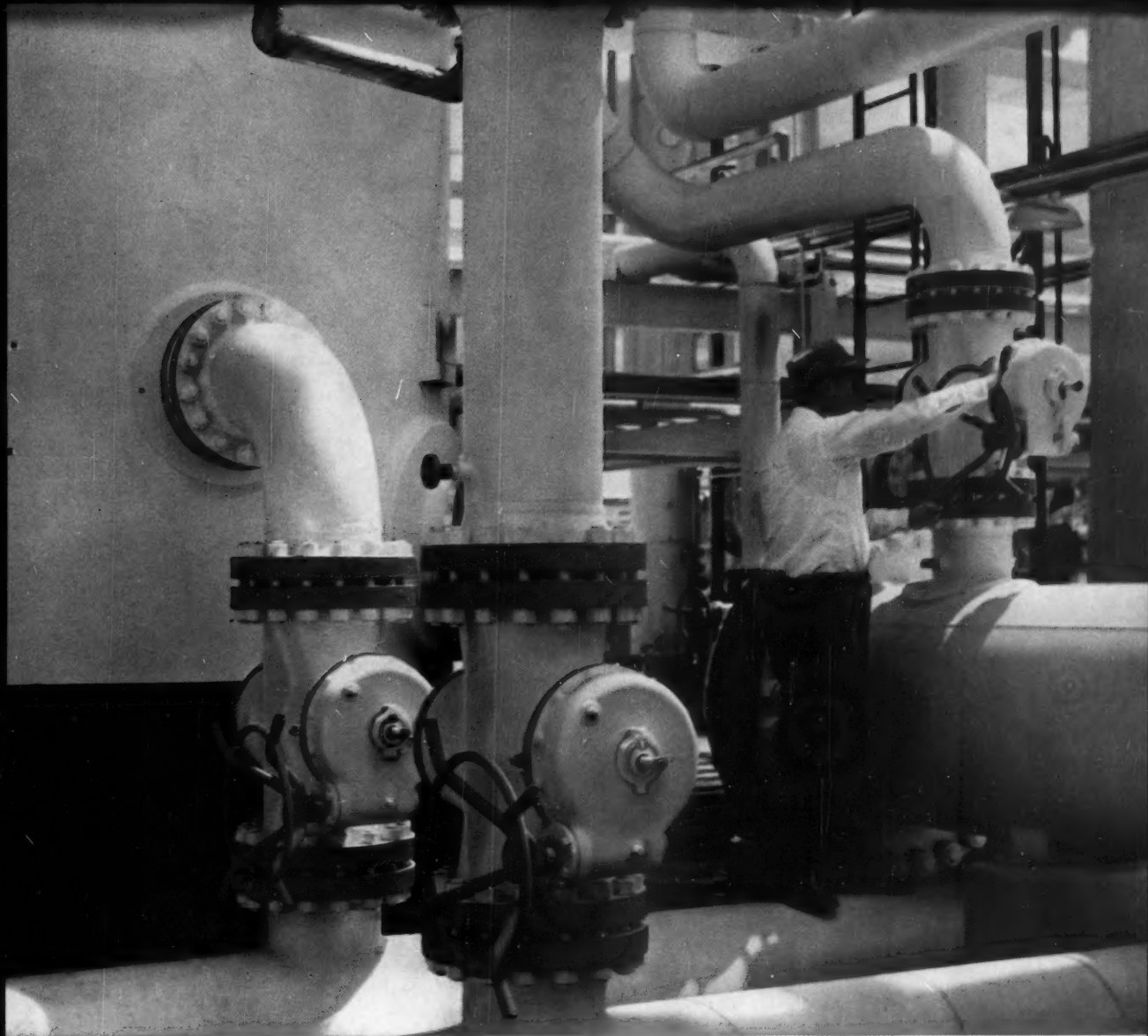
Guanos y Fertilizantes, Mexican government agency, has opened an \$8 million fertilizer plant in Puerto Mexico. It will produce 180,000 tons annually, mostly ammonium sulfate and a series of nitrophosphates.

Dow Chemical Co. has announced that it will spend \$75 million on new construction in 1956 compared with \$50 million last year.

Texas City Refining, Inc. has been granted a rapid tax amortization by the Office of Defense Mobilization to expand the alkylation unit at its Texas City, Tex., refinery: 100% on \$1.08 million and 50% on \$100,000.

Stauffer Chemical Co. has established the existence of mineable deposits of over 5 million tons of commercial grade phosphate rock on its patents near Bear Lake, Idaho.

American-Marietta Co. plans to spend \$15 million to increase its production of lime, cement and concrete pipe. Much of the new capacity will be installed at the Roberta, Ala., cement and lime plants of the Southern Cement Co. division.
(Continued on p. 350)



Why gamble your profits?

Valves are a major investment. Why gamble your profits on risky valves when you can buy the best at a price that is often lower than ordinary valves? Your valve investments are secure when you specify Rockwell-Nordstrom valves because *pressurized lubrication* assures economy and dependability in these three important ways:

1. Leakproof Sealing . . . eliminates uncertain, "forced" metal-to-metal seating.

2. Longer Life . . . lubricant stops trouble before it starts . . . slashes repair, maintenance and down time costs.

3. Instant Operation . . . lubricant "cushions" plug for smooth, quarter-turn operation.

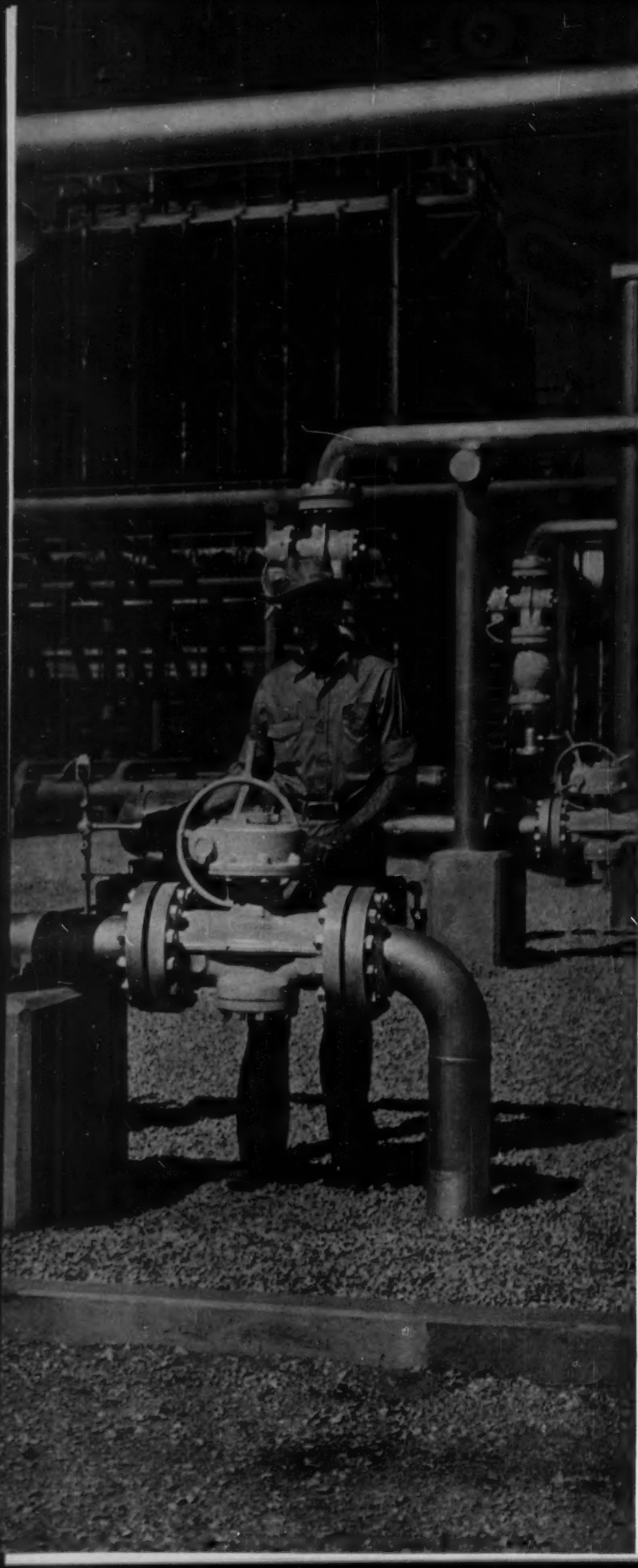
Forty years of lubricated plug valve leadership by the original and world's largest manufacturer is your assurance of economy and trouble-free dependability when you specify Rockwell-Nordstrom valves. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL-Nordstrom VALVES

Lubricant Sealed for Positive Shut-off

40th Year *of lubricated plug valve leadership*





How to handle tough services

Many services (like high-velocity gas service) eat the heart right out of ordinary valves. Metal-to-metal seating soon becomes pitted or scored and the valve won't hold. The result—expensive reseating, down time and snarled production schedules.

In Rockwell-Nordstrom valves a thin, tough film of pressurized lubricant between the plug and the valve body forms a *continuous* and *dependable* seal at any pressure on any service. The lubricant also protects against corrosive-erosive material and eliminates metal-to-metal friction for longer service life at lowest cost.

Rockwell-Nordstrom, *the original and most complete line* of lubricated plug valves are available in steel, semi-steel, stainless steel and special alloys for a complete range of pressures and temperatures. For more information, write: Rockwell Manufacturing Company, Pittsburgh 8, Pennsylvania.

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ROCKWELL- Nordstrom VALVES

**Lubricant Sealed for
Positive Shut-off**



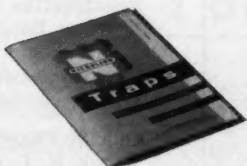
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of lubricated plug valve leadership



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extra stamina for severest service



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Branch Offices in Principal Cities

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FIRMS . . .

Battelle Memorial Institute has completed a reactor development laboratory—for use by industry and government in the development of reactors for power production and propulsion—at Columbus, Ohio.

Spencer Chemical Co. has acquired the assets of the Parker-Browne Co., Fort Worth, Tex., producers of liquid carbon dioxide and dry ice.

Cosden Petroleum Corp. expects to complete a \$3-million, 20-million lb./yr. styrene plant in Big Spring, Tex., by the end of this year.

Wyandotte Chemicals Corp. will spend \$2.5 million on cement plant facilities which will double its production bringing it to nearly 2½ million bbl./yr.

Republic Steel Corp. has negotiated an agreement under which it will buy half interest in Cramet, Inc., Crane Co.'s titanium subsidiary. Cramet has recently completed a \$25-million plant in Chattanooga, Tenn., which will supply the government with 6,000 tons/yr. of titanium sponge for the next five years.

U.S. Rubber Co.'s Naugatuck Chemical Div. has started construction of a \$5-million plant at Baton Rouge, La., to manufacture Kralastic, a copolymer based on styrene, butadiene and acrylonitrile.

Chipman Chemical Co., Bound Brook, N. J., plans immediate construction of a 2,4-D plant in Portland, Ore.

Celanese Corp. of America has started construction of new development laboratories at Charlotte, N. C.

Northwestern Chemical Co., Detroit, has just completed a major expansion of home office, plant and research facilities.

Columbia - Southern Chemical Corp. will spend \$1 million on expansion of its research and development facilities at Bar-



Liquid in suction lines of ammonia refrigeration systems can seriously damage gas compressors. Engineers at H. A. Phillips & Company, Chicago, Illinois, devised a system that automatically returns that "Slop-Over" liquid directly to the receiver, saving compressors. On all non-gravity jobs, Viking Pumps are standard equipment, delivering non-leak operation and positive pumping.

Viking engineers will welcome opportunities to work with original equipment manufacturers to solve pumping problems. For information, write for bulletin Section Hc.



VIKING PUMP COMPANY

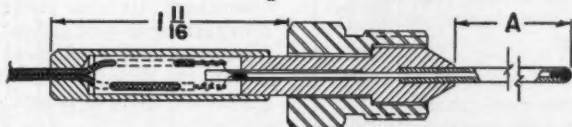
Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" pumps
See our catalog in Sweets

THERMOCOUPLE

ASSEMBLIES

**LEAKPROOF
AT**

PRESSURES UP TO
80,000 P. S. I.
TEMPERATURES TO
1,000° F



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The Aminco Thermocouple Assembly consists of an iron-constantan or chromel-alumel couple built into a high-pressure stainless steel compression fitting, and welded at the tip as illustrated. Since the mass is small, the couple responds readily to rapid changes in temperature. The constant of emf against temperature is supplied with each Thermocouple.

May be removed and installed repeatedly without damage.
Available in size (A above): 1, 2, 3, 4, 5, 6, 12, 18 and 24 in.
Write For New Superpressure Catalog No. 406-D-34



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Oil Burners

**OF THE STEAM AND
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Dual Stage BURNERS

Now, at last, the inherent advantages of both systems of fuel oil atomization are profitably yours . . . within the one new NATIONAL AIROIL Dual Stage Burner. 45 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H. R. T., Scotch Marine and Water Tube Boilers, etc. Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g. p. h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get the detailed description, illustration and specifications in the NATIONAL AIROIL Bulletin 25.

PRODUCTS

OIL BURNERS and GAS BURNERS for Industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
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MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
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1912



Incorporated
1917

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CHEMISEAL... for All-Chemical Service

Made in two types—pure duPont TEFLON, No. 711-O, and TEFLON with Graphite, No. 711-G.

Handle all types of corrosives including hazardous chemicals. Also ideal for non-contaminating service in the manufacture of pharmaceuticals, biologicals, foods, etc.

Outlast other type packings in chemical service, many times over.

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Lubrication that is impregnated into every strand of asbestos yarn, and graphitizing that is braided into the structure for life—allows shaft free motion. Keeps packing live, smooth-running.

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Camden 1, New Jersey

The Belmont Packing & Rubber Co.
Butler & Sepviva Sts., Phila. 37, Pa.

U.S. GASKET • BELMONT PACKING

FIRMS . . .

berton, Ohio. The company has also established a new district sales office at Houston.

Parke, Davis & Co. is planning to build a \$10-million medical research center in Detroit.

Esso Research Laboratories has started construction on a \$500,000 laboratory addition at its Baton Rouge, La., refinery.

Kaiser Aluminum and Chemical Corp. has signed a 20-yr., \$20-million contract to buy natural gas from the Spokane Natural Gas Co.—the first major industrial contract for gas in the Pacific Northwest. Gas will be used to heat its Mead reduction plant and Trentwood rolling mill.

National Gypsum Co. has completed a new Westwego, La., plant for gypsum building products.

Pabco Products Inc., San Francisco, will acquire complete ownership of Fibreboard Products Inc. through a \$37.8-million purchase of stock formerly owned by Crown Zellerbach Corp.

General Petroleum Corp. is spending \$500,000 on three new buildings in Santa Fe Springs, Calif., to house its southern division production department, production engineering and equipment section, gas department and production and gas laboratories.

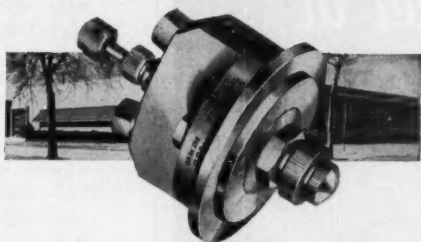
California Institute of Technology has started construction of a \$1.5-million building to be devoted to chemical and electrical engineering.

Spencer Kellogg & Sons has opened a new research center in Cheektowaga, N. Y.

General Portland Cement Co. plans a \$10-million cement plant for a site just west of Miami, Fla.

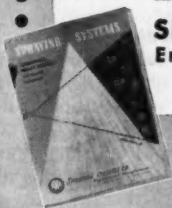
Corning Glass Works has set up a refractories division to consolidate production of con-

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In the search for doing things better and faster, have you overlooked the importance of spray nozzles? Your application may be commonplace or complex... but whatever it is, properly engineered spray nozzles can make a vast difference. Let Spraying Systems Co., America's foremost authority on industrial spray nozzles show you why and how. As a first step, write for catalog.



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the nonmelting, chemical
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Dow Corning Valve Seal retains its lubricating effectiveness at temperatures ranging from -40 to 500 F. It has excellent resistance to oxidation and a wide variety of chemicals and gases. With these properties, plus a high order of water repellency, Valve Seal increases valve life and efficiency; reduces maintenance costs; eliminates need for stocking a variety of special purpose valve lubricants; and facilitates more continuous processing.

Many uses for Valve Seal

Use Valve Seal wherever the life or efficiency of conventional lubricants are limited by extreme temperatures, corrosive chemicals, gases or steam. A few typical applications include: pressure lubricated plug valves; automatic control valves; flow meter bearings; ceramic plug cocks; pump packings; delicate equipment and recording instruments exposed to a wide range of temperatures.

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Please send me free sample of Dow Corning Valve Seal.

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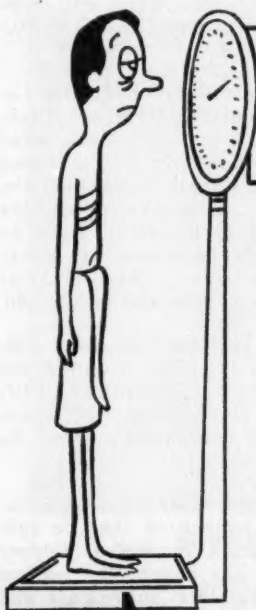
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BART LECTRO-CLAD will withstand any fabrication process that low carbon steel itself will take — without affecting the tough, durable contamination-free nickel plate.

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FIRMS . . .

ventional refractories and new special materials for high temperature operations.

H. K. Ferguson Co. of Canada Ltd. has established headquarters in Toronto, Ont.

Reynolds Metals Co. will spend \$1.5 million for additional smelting pots at Jones Mill, Ark., to increase aluminum-plant capacity to 200 million lb./yr. The company has also set up a new divisional sales office in Newark, N. J.

Antler Wood Products Ltd. plans a \$20-million pulp mill in the Whitecourt area northwest of Edmonton, Alta.

General Electric Co. has established headquarters in San Jose, Calif., for its atomic power equipment department.

Regent Refining (Canada) Ltd. is adding a \$5.5-million fluid catalytic cracking plant to its refining facilities at Port Credit, Ont., which will raise capacity from 14,000 to 20,000 bpd.

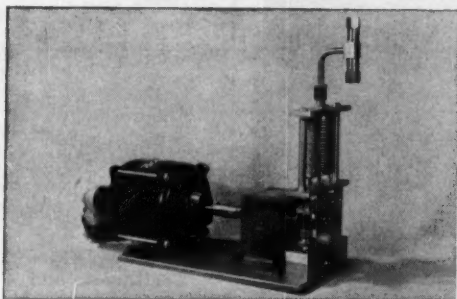
Combined Metals Reduction Co. is rebuilding its Bauer, Utah, resin plant which was levelled by fire last year. At the same time, **United States Fuel Co.** is building a resin flotation plant at Hiawatha, Utah, to supply the needs of the Bauer installation. Total cost of both installations is \$500,000.

Miles Laboratories, Inc., Elkhart, Ind., has acquired the Takamine Laboratory, Clifton, N. J., which will henceforth operate as a Miles division.

Tennessee Corp., Atlanta, Ga., has announced that its subsidiary, **Tennessee Copper Co.,** has bought the sodium hydrosulfite, sulfoxalate and zinc oxide manufacturing facilities of the **Esmond Chemical Co., Esmond, R. I.**

Allied Securities Ltd., Saskatoon, Sask., has started construction on a \$2-million plant to manufacture wall-board from wheat straw, by-

New! Explosion Proof Motor



In the Corson-Cerveny Micro-Bellows Pump

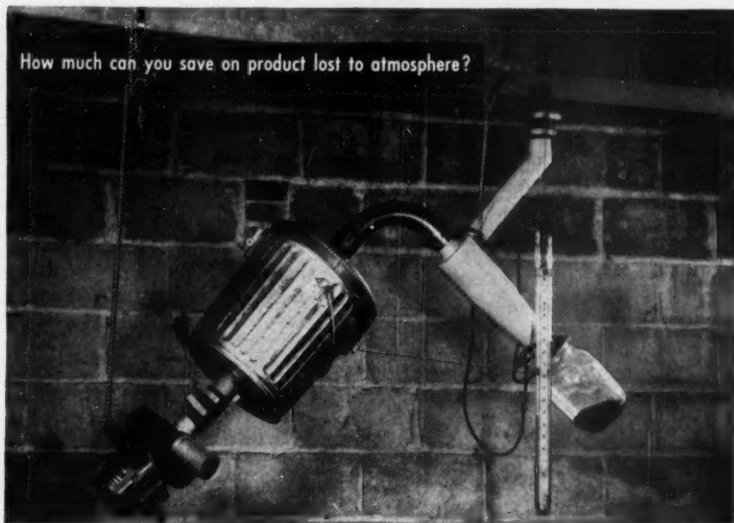
In this model of the Corson-Cerveny Micro-Bellows Pump, the motor is totally enclosed and sealed, in other words is explosion proof. (Underwriters' Laboratories approved.)

It has all the other features of the regular model Corson-Cerveny Micro-Bellows Pump plus a maximum working pressure of 500 lbs.

All parts of the Corson-Cerveny Micro-Bellows Pump in contact with the liquid being pumped are made of stainless steel and machined so that they fit together without packing, gasket material or any pipe compounds, preventing contamination of material being pumped. Write for complete information.

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The **PROOF** is in this **TEST!**

Don't let valuable product go up your stack when you can bag it for profit! Need proof of this statement? Dustex can give it to you with the simple test equipment illustrated which gives accurate figures on efficiencies, hourly collection rate and stack losses, if any, to be expected after installation of Dustex Collectors. This test is run without shutdown or interference to production and gives you the facts as they apply to your individual operation. Used throughout the food and chemical industries for the dry collection of fines without filter media, Dustex Collectors are operating with efficiencies of 99.5%+ on a diversified list of products ranging from spray dried coffee to polyvinyl chloride. For proof on how you can bag more profit — request a copy of our Determination Test booklet,



BOX 2520

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of Filtering, Mixing, Storing



Regardless of the size or type of your installation, whatever your process may be, there's an Alsop Filter, Mixer, and Storage and Mixing Tank to "fit your job". You can be sure of getting from Alsop the right unit properly applied—you can depend on Alsop proved performance features. Alsop Filters, Mixers, and Tanks are available in a complete range of sizes and capacities, and Alsop Equipment is custom fitted to your application by engineers who have thorough experience in Filtration and Agitation. For full information, recommendations and quotations write Alsop Engineering Corporation, 1104 White Road, Milldale, Connecticut.

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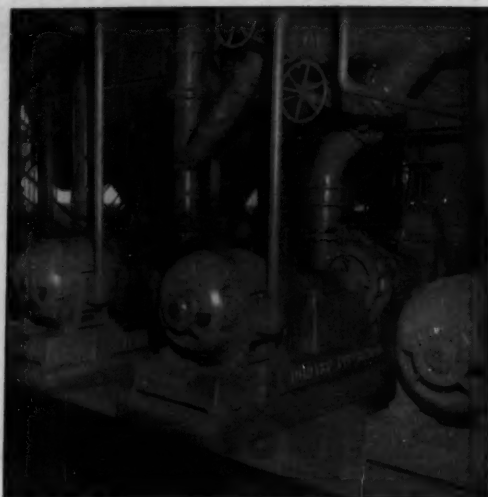
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McNally Centrifugal PUMPS

Special Built McNally Pittsburg centrifugal pumps are used to handle abrasive and corrosive sludges, slimes, and slurries. They give maximum pumping service for years.

In these slurry pumps, the volute, impeller, wearing plate and suction nozzle are cast of McNally specification NiHard. The pumps are of open impeller, single stage type. They are direct connected, or v-belt driven, depending on the type of service and installation requirements.

SPECIAL DESIGN

McNally Pittsburg designs special centrifugal pumps to your requirements; or builds special pumps to your design. For Information Write to Either Plant.

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MANUFACTURING CORPORATION

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First National Bank Bldg., Pittsburgh, Pa.

PLANTS: Pittsburg, Kansas Wellston, Ohio

FIRMS . . .

product in the production of building board.

Chemische Werke Huels Co. is building a 45,000-ton/yr. synthetic rubber plant in Narl, the Ruhr section of Germany, to begin operation early in 1957.

Fertilizers and Chemicals Co. of Haifa started operations of a \$4-million ammonia synthesis plant in Israel.

Bayer Chemical plant has just opened a modern isotope laboratory in the heart of the industrial Ruhr, Germany.

Diamond Alkali Co. has established two new autonomous divisions: the electro chemicals division and the soda products division.

Stillman Rubber Co., Culver City, Calif., has acquired the Extruded Products Co., Fullerton, Calif., which extends Stillman production in the field of extruded rubber and silicone tubing.

Zonite Products Corp. plans to build a new general office and laboratory in Passaic County, N. J.

Reeves Instrument Corp. has taken over a modern \$5-million plant and added facilities at Mineola, N. Y., for expanded production of electronic and electro-mechanical systems, industrial automation devices.

Arthur G. McKee & Co., steel, petroleum and chemical engineering firm, is building a \$500,000 headquarters in Cleveland.

Atomic Energy Commission's Mound Laboratory will receive about \$1.3 million in additional equipment and plant changes this year.

Lion Oil Co., a Monsanto division, has opened new chemical sales offices in Des Moines, Iowa.

Garfield Chemical and Mfg. Co. will complete a new \$2.5-mil-

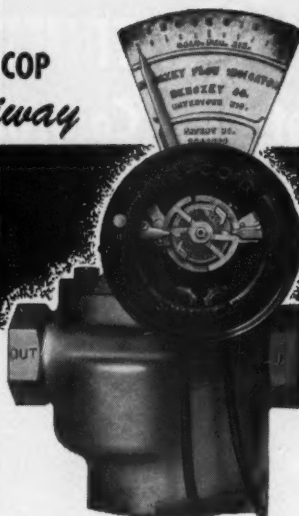


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on your fluid hiway

HENSZEY FLOW METERS with Alarm Control

**RINGS A BELL—LIGHTS A LIGHT or
ACTIVATES a MOTORIZED VALVE**

There are only three moving parts in the HENSZEY FLOW METER — no breakdown due to complicated gears and mechanism. Goes right in the line — no additional supports. Indicates flow within 3% absolute accuracy, even with pulsating flow. Send for bulletin.



**SOUND ALARM AT
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Easy to set on face of switch — unaffected by dust, dirt or corrosion — no pitting or sticking.

HENSZEY COMPANY

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WATERTOWN, WISCONSIN

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1896

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PHOSPHORUS OXYCHLORIDE	HYPOPHOSPHOROUS ACID
PHOSPHORUS TRICHLORIDE	ALKYL ACID PHOSPHATES
PHOSPHORUS PENTACHLORIDE	(Alkyl Phosphoric Acids)
PHOSPHORUS PENTASULFIDE	SODIUM CHLORATE
PHOSPHORUS SESQUISULPHIDE	POTASSIUM CHLORATE
AMORPHOUS PHOSPHORUS	POTASSIUM PERCHLORATE
PHOSPHORIC ANHYDRIDE	HYPOPHOSPHITES
PHOSPHORIC ACID	OXALIC ACID

ZINC PHOSPHIDE

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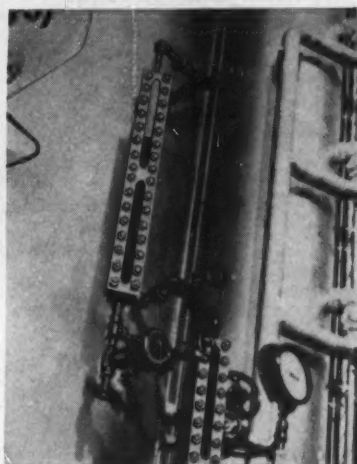
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NIAGARA FALLS, N. Y. COLUMBUS, MISS.

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Factory Mutual Approved

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THE sharp black-white contrast of the level of any color liquid, against the empty space above, in Jerguson Series #5 Reflex Gages, makes possible highly accurate liquid level readings even where lighting is poor.

Gages are made of any material to withstand corrosive liquids. Glasses are specially treated with Jerguson Anti-Fouling Compound to give clearest visibility over a long period. Special illuminators available.

Series #5 Low Pressure Reflex Gages are available in sections to give you any desired total gage length. Materials used are selected to conform to or exceed the rigid requirements of A.I.S.I., A.S.T.M., and/or A.P.I.-A.S.M.E. specifications.

You can depend on Jerguson Gages. Write today for full information on Series #5 Gages, or for help on any gage problem.

JERGUSON

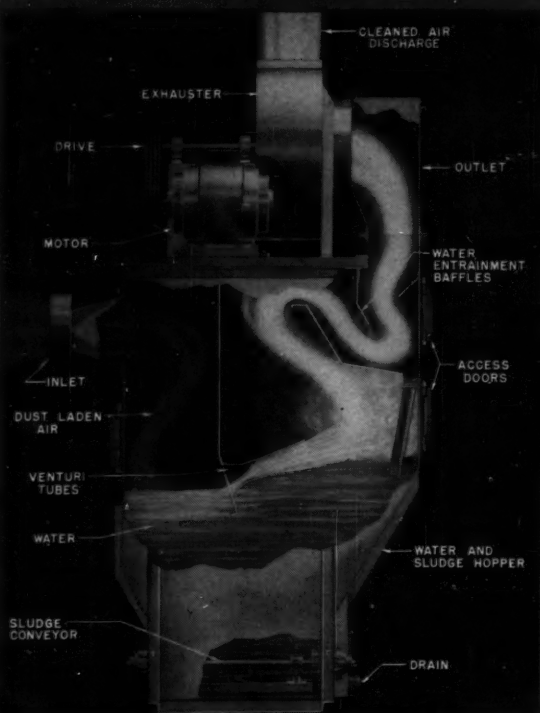
Gages and Valves for the
Observation of Liquids and Levels

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100 Fellsway, Somerville 45, Mass.

Offices in Major Cities
Jerguson Tross Gage & Valve Co., Ltd., London, Eng.
Pétrole Service, Paris, France

NEW PANGBORN VENTRIJET

Gives Efficient Wet Dust Control



Efficient wet dust collection depends on breaking water into particles and mixing it with the dust. The new Pangborn VENTRIJET Collector utilizes venturi tubes to achieve this effect. As dust-laden air enters the inlet chamber, heavier dust particles sink to the bottom. The air stream then passes through the venturi tubes at high velocity, drawing water with it and breaking it into minute particles. These particles mix thoroughly with the remaining dust in the air and give the VENTRIJET its high operating efficiency. In the outlet chamber, the resulting sludge settles to the bottom for removal. Eliminator sections remove water droplets in the washed air and the cleaned air is then discharged. The result is peak performance in a minimum of space.

Pangborn VENTRIJET offers these advantages:

- Complete, self-contained unit with low headroom, minimum floor space
- High air velocity through venturi tubes insures thorough mixing of air and water
- Venturi tube design results in minimum pressure loss and provides uniform flow—no narrow channels to become choked with sludge
- Tube design and thorough washing action enable collector to handle heavy loads.

For full details, write to PANGBORN CORPORATION, 2600 Pangborn Blvd., Hagerstown, Maryland.

Visit "Pangborn Institute" at AFS Show, Atlantic City, May 3-9

Pangborn

CONTROLS DUST

FIRMS . . .

lion unit for its sulfuric acid plant at Garfield, Utah, this fall.

Joy Mfg. Co., Pittsburgh, has launched a new research and testing facility in Buffalo to be known as its turbo-dynamics division. Division work is aimed at development of prototypes and establishment of designs for regular manufacture.

Merck & Co., Rahway, N. J., has consolidated its research activities in a new division called Merck, Sharp & Dohme Research Laboratories.

Pittsburgh Coke & Chemical Co., Pittsburgh, Pa., has consolidated its coal chemicals and plasticizer divisions into the newly-created industrial chemicals division.

Central Scientific Co., manufacturer of scientific instruments, laboratory apparatus and chemicals, is opening a new branch at North Birmingham, Ala.

E. I. du Pont de Nemours & Co. has established a separate western district office at Menlo Park, Calif., to handle sales and technical service to users of its Freon refrigerants and aerosol propellants in the area west of the Rockies.

Standard Oil Co. of Texas is expanding its El Paso refinery to boost output from 36,000 to 61,000 bpd.

McIntire Co., Livingston, N. J., has formed an industrial division to develop and market filters, driers and other products for use outside the refrigeration industry in which it has formerly specialized.

Crown Zellerbach Corp. is building a \$2.5-million, 3,720-ton/mo. corrugating and container-making plant in Antioch, Calif.

Armour Research Foundation has announced a \$5-million expansion to be completed over the next 10 yr.

MARSH MAKES IT!



If it's a pressure gauge or dial thermometer, Marsh makes it... and makes it better. The types, ranges and case styles are endless. What is "special" to other instrument makers is often standard to Marsh. To know the scope of Marsh instruments—

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this
fact-filled
catalog



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For a perfect spray, many plants prefer Monarch nozzles.

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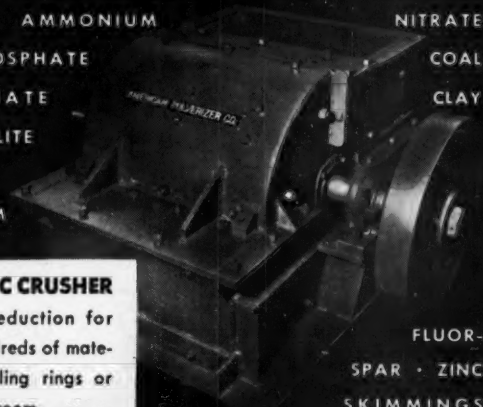
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- GAS SCRUBBING
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Efficient, controlled reduction for scores of industries, hundreds of materials. Equipped with rolling rings or hammers. Minimum headroom.

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Monarch

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2517 E. ONTARIO ST.
PHILADELPHIA 34, PA.



"You say I can see vibration, measure it, and eliminate it?"

1 "How much vibration do you think my machine has?"

No need to guess—the Veelos Vibration Analyzer shows exactly! This amazing electronic tester measures vibration amplitude down to *2-millionths of an inch*—tests one belt against another, actually shows which belt has "invisible shakes" . . . and how much! Don't guess about vibration; it's costing you hard cash every minute you ignore it. Ask your Veelos salesman to test your belts with the Vibration Analyzer.

2 "Isn't vibration caused by a number of things?"

Vibration can be caused by bearings, motor, clutch, sheaves or V-belts. Quite often it is caused by V-belts alone. The Veelos Vibration Analyzer uses a "strobe" light which "stops" the motion—shows exactly *what* is vibrating! It shows you precisely how much vibration you're paying for, and lets you correct it. The Vibration Analyzer gives positive proof, and the test takes only 15 minutes. It's free, of course.

3 "How do I eliminate costly belt vibration?"

Install Veelos, in place of ordinary V-belts! V-belts have spots of varying density, due to their construction, which throw them out of balance. Veelos belts are absolutely uniform; every stud and link is identical; *every foot of the reel* is identical and uniform; and they're perfectly balanced! Test any belt for vibration against Veelos—you're in for a shock. Your Veelos salesman will show you how to cut costs and improve your operation.

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Veelos is known as
Veelink outside U.S.A.

For free vibration analysis or
Veelos Data Book write to:

MANHEIM

Manufacturing & Belting Company
210 Stiegel St., Manheim, Pa.

**"Industrial Belt
Specialists Since 1911"**



Adjustable to any length • Adaptable to any drive • Balanced power • Constant power • Vibrationless power

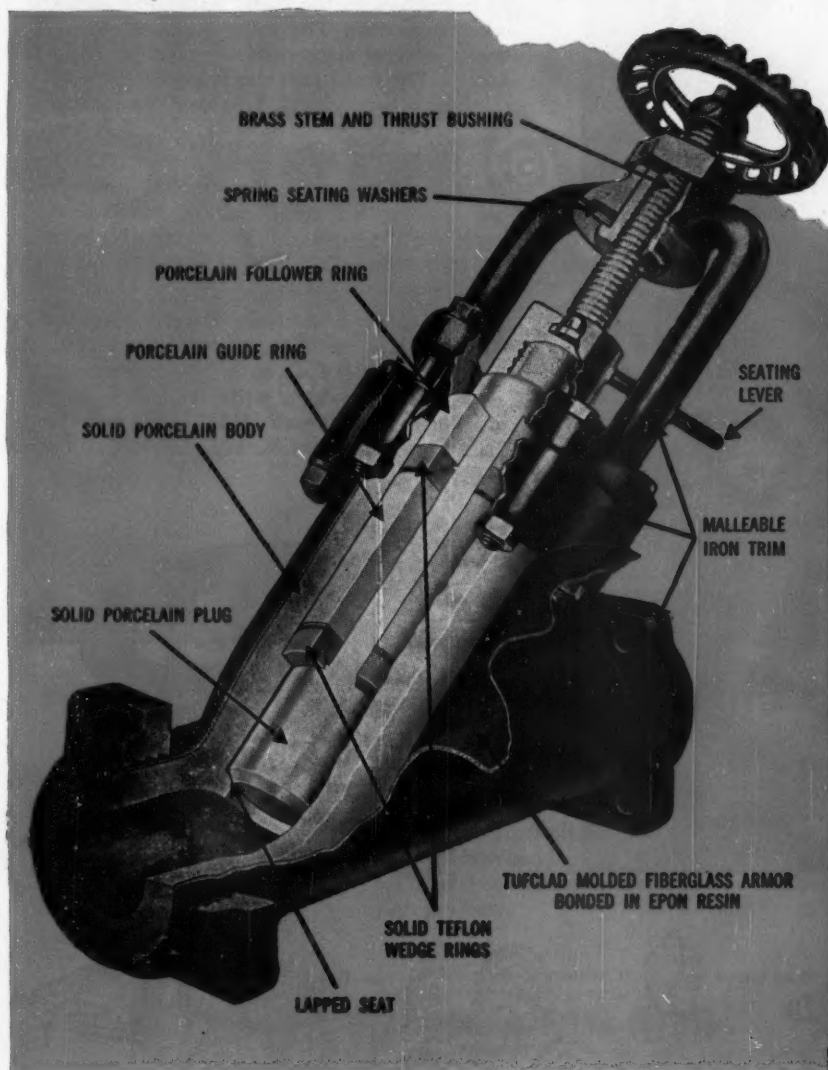
Precision Grinding of Solid Porcelain

in the Lapp Valve



The high firing temperature, which assures complete vitrification and zero porosity of Lapp Porcelain, also makes impossible the maintaining of close dimensional tolerances. Necessary tolerances are achieved, however—in regular production $\pm .001$ "—by machine grinding with silicon carbide wheels. In the Lapp Valve, the entire stuffing box chamber, seating area, plug, guide and follower rings are finish ground, for precision assembly and complete interchangeability of parts. In addition, each porcelain plug is individually lapped and polished into its seat integral in the valve body. (No separable seating parts.) Each such valve seal is tested to 150 psi hydrostatic pressure before the valve is shipped.

Write for bulletin with complete description, characteristics, and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 800 Wendell St., LeRoy, New York.



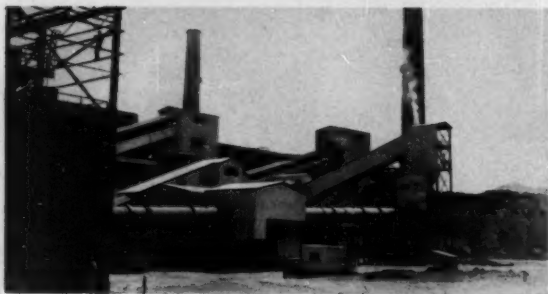
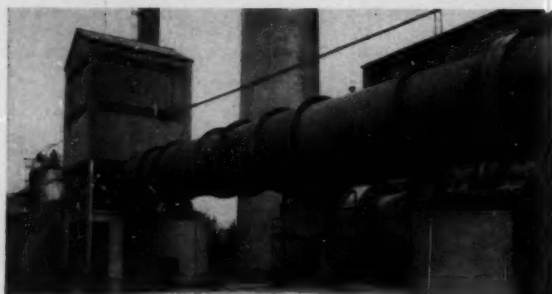
Y-valves, angle valves, flush valves, safety valves, and plug cocks of Lapp Porcelain have standard bolt-circle flanges for easy connection to all piping and equipment.

Lapp

PROCESS EQUIPMENT

Chemical Porcelain Valves
Pipe • Raschig Rings • Pulsafeeder
Chemical Proportioning Pumps

IMPROVING QUALITY... REDUCING COSTS FOR LEADING CHEMICAL PROCESSORS



Throughout the chemical industry... wherever you find a sizeable thermo-processing operation... you'll find a Traylor Rotary Kiln on the job protecting product quality, reducing maintenance bills and lowering production costs.

Traylor's half-century of engineering experience has produced many major improvements that have become accepted standards for modern kiln design. Cast steel or forged steel riding rings, of the full-floating type are specially mounted to hold them securely in place relative to the easily adjustable single roller supports. The roller supports are of heavy integral design and can be adjusted as a unit. The shells are extra heavy with ample reinforcing bars. Thus, Traylor Kilns achieve exceptional thermo-processing and maintenance economies.

The success of Traylor Rotary Kiln design is best emphasized by the large number of leaders in the processing industries who have returned time after time to purchase additional Traylor Kilns.

Traylor has custom built Rotary Kilns in sizes to 12' in diameter and 450' in length. For full specifications on a kiln to best suit your specific product, write for a free copy of illustrated bulletin 1115 outlining the features of Traylor Rotary Kilns, Coolers and Dryers.



TRAYLOR ENGINEERING & MFG. CO.
842 MILL STREET, ALLENTOWN, PA.

SALES OFFICES: New York • Chicago • San Francisco
Canadian Mfr: Canadian Vickers, Ltd., Montreal, P.Q.



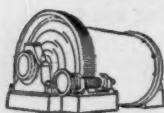
PRIMARY GYRATORY CRUSHERS



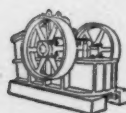
ROTARY KILNS



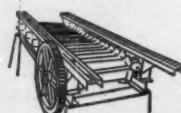
SECONDARY GYRATORY CRUSHERS



BALL MILLS



JAW CRUSHERS



APRON FEEDERS

EXON: each resin engineered for a specific problem



EXON 654

specifically for

Plastisols



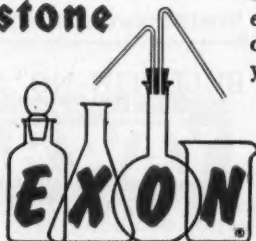
No grinding needed when you use Firestone plastisol resin. An extremely fine powder with high molecular weight, EXON 654 readily disperses in plasticizer with simple stirring equipment.

EXON 654 is expressly created to impart excellent heat and light stability, physical toughness and chemical stability to your products.

Pastes formulated from EXON 654 show exceptional viscosity stability and flow properties. Unsurpassed for processing ease and efficacy in coating fabric and paper, they endow these products with unusual tear and wear resistance.

Whatever your particular problem, you're likely to find the specific remedy in one of the many EXON resins.

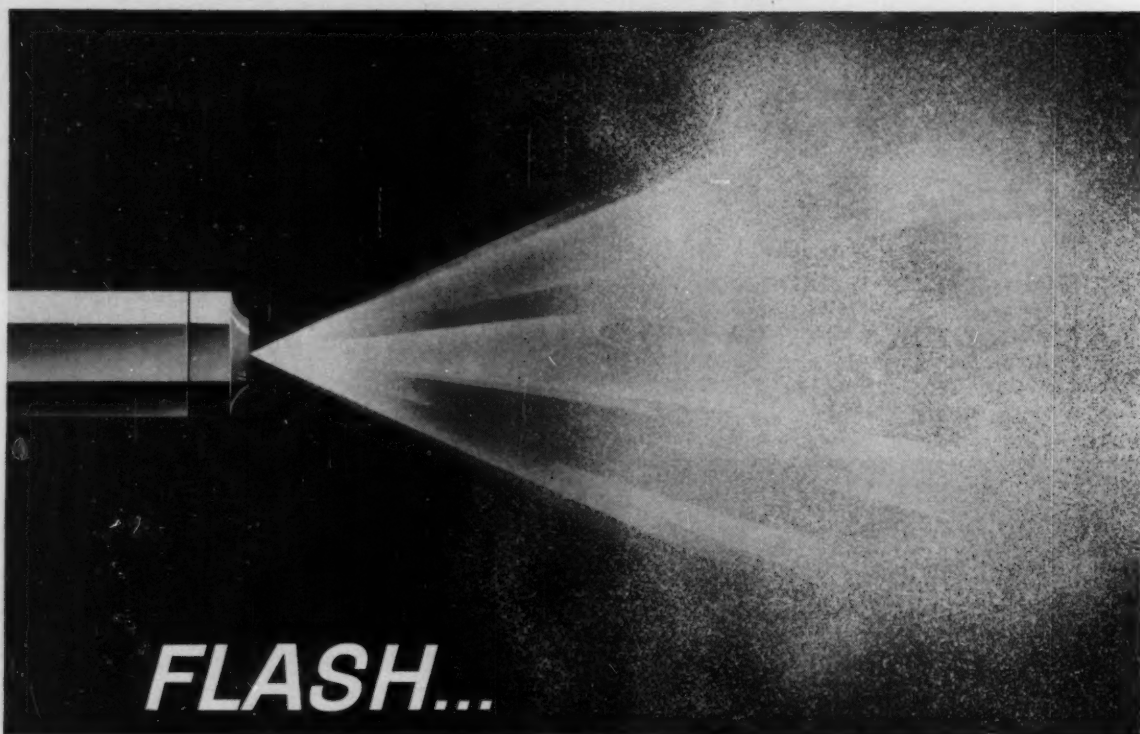
Firestone



For complete information or technical service on the entire line of EXON resins, call or write today.

CHEMICAL SALES DIVISION

FIRESTONE PLASTICS COMPANY, POTTSTOWN, PA., DEPT. 628F
DIVISION OF FIRESTONE TIRE & RUBBER CO.



and it's dry with a Buflovak SPRAY DRYER

Gives chemicals, pharmaceuticals,
food products NEW characteristics
... NEW markets

From liquid to dry product ... instantaneously ... and at minimum cost ... in compact but accessible equipment that is easily and economically maintained ... those are some of the advantages Buflovak SPRAY DRYERS provide.

A dry product is produced instantaneously in a Buflovak SPRAY DRYER. The liquid is atomized and sprayed into the center of a hot air stream. Evaporation occurs instantaneously and the dried product is removed from the heating zone so quickly that all its desired characteristics are retained. The operation is fast, sure and economical.

Our engineers will gladly analyze your drying problem and make sound, practical recommendations based on your requirements. A pretest of your product in the Buflovak Research Laboratory and Testing Plant can be arranged. Complete information on request.

Cost-cutting FEATURES of the Buflovak SPRAY DRYER

- HIGH RECOVERY OF SOLIDS—by the most efficient collecting system
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- LOW COST OF OPERATIONS—low power and heat consumption
- EASY TO CLEAN—complete accessibility
- LOW MAINTENANCE COST—only a few moving parts ... no filters or bags to replace
- CONTROLLED CHARACTERISTICS OF THE DRY PRODUCT—suitable for market with or without further processes ... ready for immediate use

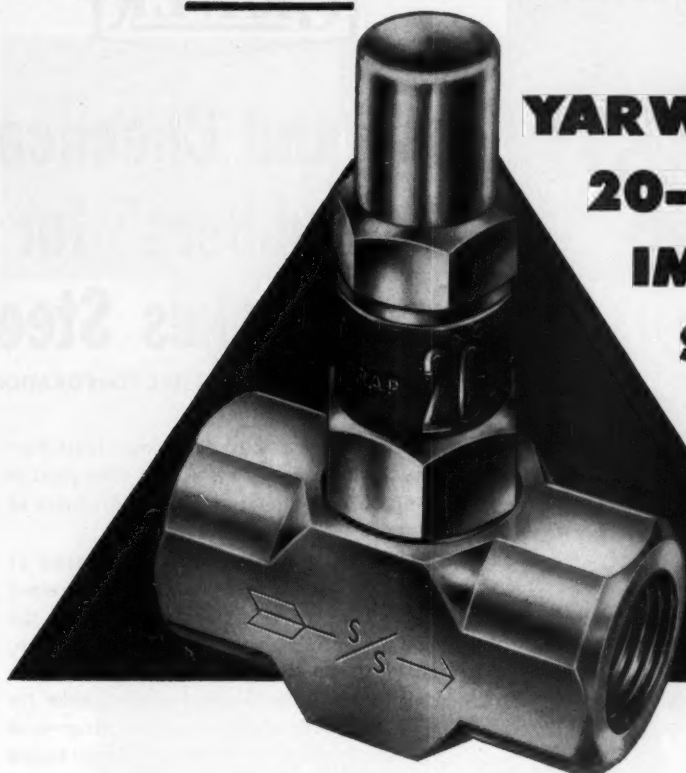
ASK FOR BULLETIN NO. 373



BLAW-KNOX COMPANY

Buflovak Equipment Division, 1551 Fillmore Avenue, Buffalo 11, N. Y.

THE RIGHT STEAM TRAP FOR LIGHT CONDENSATE LOADS



YARWAY 20-A IMPULSE STEAM TRAP

● Successful companion to the standard Series 60 YARWAY Impulse Steam Trap, the 1/2" No. 20-A is right and recommended for *light load* applications in:

REFINERIES, CHEMICAL AND PROCESSING PLANTS on steam tracer lines, meter boxes, steam mains, separators, small dryers, pipe coils, small unit heaters, etc.

POWER PLANTS on headers, fuel oil preheaters, compressed air lines, small steam jacketed fire pumps, etc.

HOSPITALS, SCHOOLS, HOTELS AND INSTITUTIONS on autoclaves, sterilizers, steam tables, washers, small pressure cookers, steam mains, etc.

LAUNDRIES on small presses, puff irons, sock forms, drying cabinets, starch cookers, steam mains, etc.

The 20-A has all the YARWAY Impulse Trap features such as small size, stainless steel body and working parts, low cost, non-freezing—and immediate availability through 270 local Industrial Distributors.

Write for Bulletin T-1739-X.

YARNALL-WARING COMPANY
137 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY **IMPULSE[®]**
STEAM TRAP

OVER 1,000,000 YARWAY IMPULSE STEAM TRAPS USED

There's a Yarway Impulse Trap for every trapping need



SERIES 60 AND 120

For all normal trap requirements, pressures to 400 and 600 psi.



1/2" No. 20-A

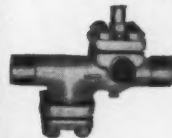
For light loads on tracer lines, steam mains, small presses, etc.



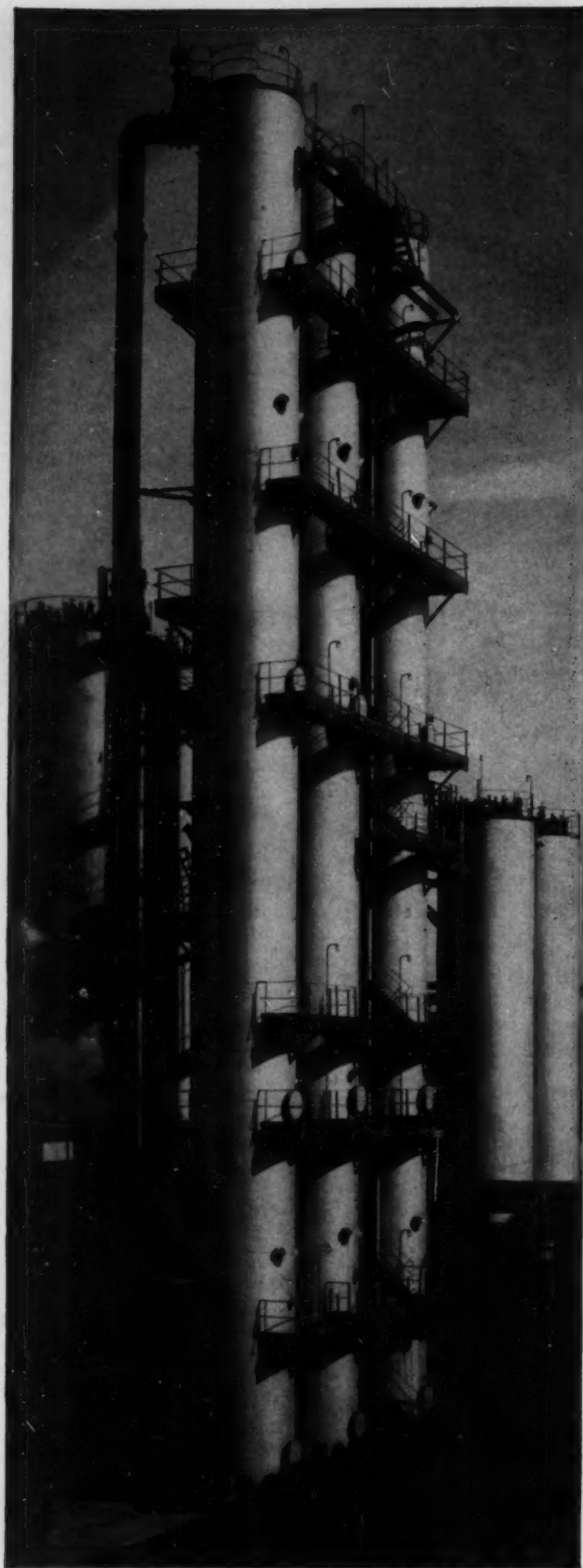
SERIES 40

For heavy loads requiring extra high capacity steam traps.

INTEGRAL-STRAINER HIGH PRESSURE TRAP



For high pressures, high temperatures. (Flanged or welding connections.)



GRAVER

Gas and Chemical "scrubbers" for Great Lakes Steel

(DIVISION OF NATIONAL STEEL CORPORATION)

At Great Lakes Steel Corporation's Blast Furnace Division, a new by-product coke plant is equipped with a total of 25 large examples of Graver's craftsmanship in steel.

These structures, shop-fabricated at Graver's East Chicago plant and field-erected on the site by Graver crews, were built to the designs of Wilputte Coke Oven Division, Allied Chemical & Dye Corporation. These include bins, stacks, gas coolers, tanks for chemical feed, storage, and settling—and scrubbers such as the three 132' towers shown at the left.

This variety of quality fabrication indicates Graver's versatile craftsmanship—demonstrates Graver's ability to shop-fabricate and field-erect structures for the steel, petroleum and chemical industries. For process and storage equipment in steels, alloys or clads, Graver's offices across the country are staffed with competent engineers ready to serve you.

GRAVER ...craftsmen in carbon,
stainless and alloy steels

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

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LOS ANGELES • EDGE MOOR, DEL. • TULSA • SAN FRANCISCO

mass spectrometry

out of the laboratory...into the plant



COMPANION INSTRUMENTS

Both the 21-610 and 21-620 Mass Spectrometers are flexible and simplified, need only 115 volts and a small supply of cooling water, are easily moved around the plant. The Type 21-610 is useful for monitoring streams with components to mass 80. The Type 21-620 employs the newly developed "Cycloidal Focusing" principle, is usable for accurate readings from mass 2 to mass 150.

CEC's two companion instruments... Types 21-610 and 21-620... have taken mass spectrometry out of the purely laboratory-instrument class and made the inherent speed and accuracy of this analytical method practical for industrial use. As a process-stream analyzer, the mass spectrometer is exceptionally versatile, provides stream-composition information *on the spot* for regulating plant start-up procedures, optimizing operations and products, and minimizing process interruptions.

SEVERAL MODES OF OPERATION

Both 21-610 and 21-620, together with available accessory systems, work on either a batch or continuous basis, permit...

- continuous determination of a single component
- alternate determination of several components
- automatic scanning of a complete spectrum
- programming up to six mass numbers for automatic, repetitive monitoring
- alternate monitoring of more than one process stream through automatic manifolding, valving, and timing systems.

APPLICATION...INSTALLATION

CEC's Application Engineers offer without charge experienced help in fitting the mass spectrometer to your specific application. In addition, all mass spectrometers are installed and put into initial operation by a skilled CEC Field Service Engineer. Send today for Bulletin CEC 1824B-X2.

Consolidated Electrodynamics
formerly Consolidated Engineering Corporation

300 North Sierra Madre Villa, Pasadena, California • SALES AND SERVICE OFFICES IN:
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ELECTRONIC
INSTRUMENTS FOR
MEASUREMENT
AND CONTROL

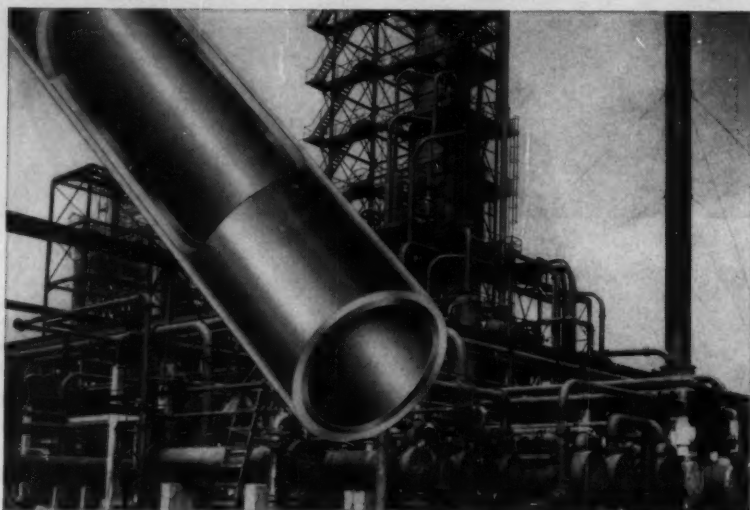
BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN



MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



The Inside and Outside Story of Duplex Tube

In cases where a different type of corrosion attacks each side of a heat exchanger tube, many users of heat exchanger tubes have found that tubes made of a single metal often are not a solution to both corrosion problems. This is the reason why Bridgeport Duplex Tubes were developed—*because a one-metal tube had not proved itself the universal answer to dual corrosion.*

Bridgeport Duplex Tubes are supplied in more than 100 combinations of ferrous and nonferrous metals. Their economy has been clearly proved. If your heat exchanger tubes are failing to give you all the service life you think you should get, it is very likely that Duplex Tube—which takes advantage of the best qualities of *both* metals—can save you money. Our specialists will be glad to study your problems, and assist in selecting a combination of tube that best fits your needs.

Installation of Duplex Tube is not suggested as the solution to *every* tube problem. But where dual corrosion conditions exist, Duplex Tubes can save money. Before we recommend Duplex Tube, each alloy is carefully selected to withstand the specific corrosion problem on each side of the tube. Pitting

or cracking—faults frequently found in certain types of one-metal Tubes—is often eliminated by Duplex Tubes. By gauging the thickness of inside and outside tube walls to the rate of corrosion, longer and uniform tube operating life are assured.

Heat transfer properties of Duplex

RESULTS OF HEAT TRANSFER TESTS DUPLEX VS. SINGLE WALL TUBE

Steam Condensed on Outside Surface With
Fresh Water Passing Through The Tubes

Water Velocity Feet per Second	OVERALL HEAT TRANSFER RATE AT INDICATED WATER VELOCITY BTU./HR./SQ. FT./° F.	
	Duplex Tube ¾" O.D. x Wall Thicknesses .0325" and .0325"	Regular Tube ¾" O.D. x Wall Thicknesses .065"
2½ 3½	Steel to Steel	Steel
	371 458	380 458
2½ 3½	Copper to Copper	Copper
	580 750	600 740
2½ 3½	Steel to Copper	Steel
	465 625	380 458

are often actually better than those of single-wall Tube. This is a result of Bridgeport's method of manufacture which insures a good, tight mechanical bond between the two alloys. The table illustrates why smaller or more efficient heat exchangers are possible with Duplex Tube.

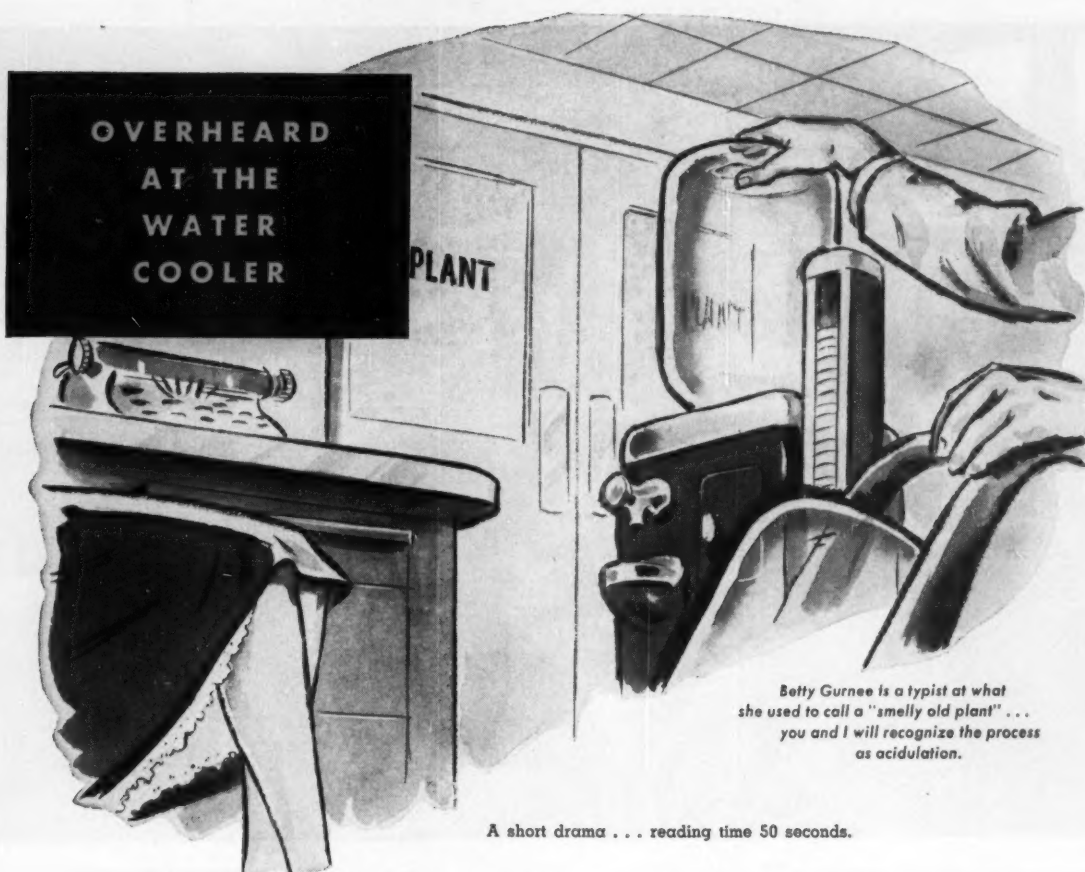
Heat exchanger tubes that do not give full service life cannot give their operators their money's worth. The service that tubes will give should be balanced by the costs of maintenance, retubing and, of course, the original cost of the tubes. Here, as an example, is the experience of one oil refiner. His first heat exchanger tubes of Low Carbon Steel had lasted only 4 to 5 weeks, and each retubing job cost him more than the tube itself. He then replaced the Low Carbon Steel with another more highly resistant tube, and operating life increased to 3 months. Still not satisfied that he was getting maximum service life for his investment he installed Duplex Tube, stainless steel to the product side and a copper alloy to the cooling side. That was *two years ago*, and his Duplex Tubes are still giving excellent service.

For chemical plants producing colorless formaldehyde, we have supplied Duplex Tubes with Admiralty on one side for brackish water, and aluminum on the outside. For oil refining and natural gas refining, we have made Duplex Tube with steel outside to resist various corrosive vapors, gases and oils; and copper or copper-base alloys inside toward fresh or salt water.

Such experiences with Duplex Tubes have been successful for many years in oil refining, production of synthetic rubber, process industries, chemical plants, coke by-product plants, ammonia production and ammonia refrigeration systems, and other applications. Duplex Tubes have proved repeatedly to be the least expensive equipment over long periods of time because of longer service life and a reduction in frequency of retubing and shut-down periods.

Write today for your copy of Bridgeport Technical Bulletin #1954, describing properties, applications, installation methods and other important Duplex Tube information. (660)

OVERHEARD
AT THE
WATER
COOLER



Betty Gurnee is a typist at what she used to call a "smelly old plant" . . . you and I will recognize the process as acidulation.

A short drama . . . reading time 50 seconds.

He: "Got a bunch of camels around here now? I used to fill this bottle twice a week."

Betty: "Nobody, I repeat, *nobody* used to miss that water cooler on their way out of the plant. But, since we got the new doo-dad out there . . . why, it's almost like a bonus."

He: (*Exit, with bottle, muttering*)

That "doo-dad" was a Simpson Mix-Muller. Betty's Boss had two reasons for buying it and only one had to do with personnel relations. He found that the Mix-Muller saved him the cost of ventilating one whole section of his plant. With it, he was able to control dust and noxious fumes from acidulation *at the mixing source* . . . because the Simpson Mix-Muller can be *readily* adapted for air exhaust or completely enclosed.

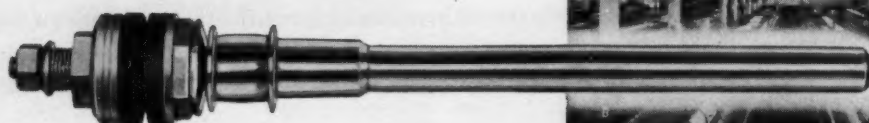
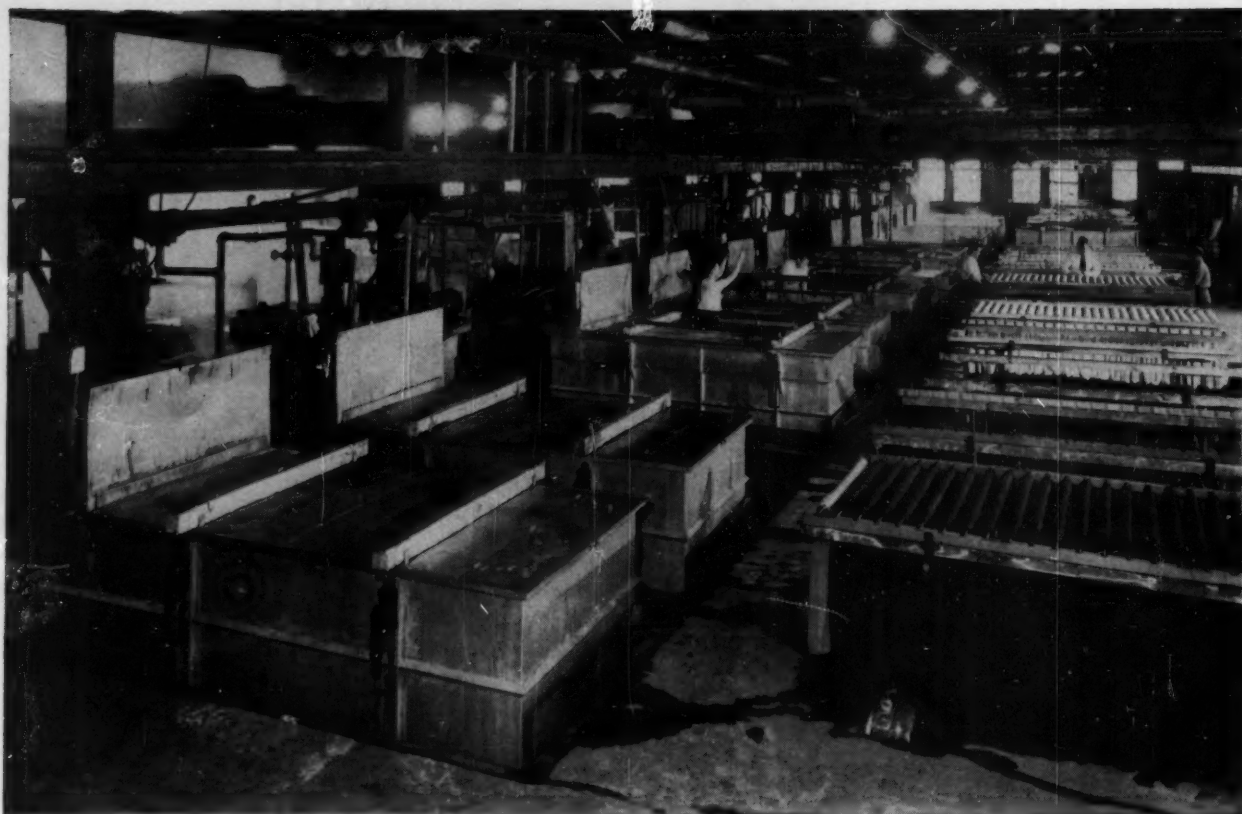
Control of dust and noxious or toxic fumes from dusty and dangerous processes is only one of the many adaptabilities of the Simpson Mix-Muller. It can be as easily adapted for heating, cooling or chemical reaction while mixing because it's designed and built to act as an integral *part of a process*. Some of these processes are described in our new "Handbook on Mulling". Write for your copy today and remember . . . mixing and the integration of mixing facilities is our *business* at National, it has been for over 40 years.



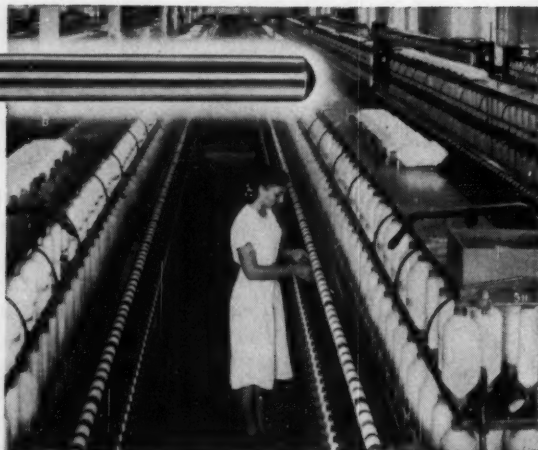
SIMPSON MIX-MULLER® DIVISION

NATIONAL ENGINEERING CO., 636 Machinery Hall Bldg., Chicago 6, Ill.





PROTECTION AT 10,000 RPM. There's no place for eccentric tubing or non-uniform wall thickness in textile mill spindles that must turn at 10,000 rpm. That's why they are made from Republic ELECTRUNITE Steel Tubing. Uniform wall thickness and concentricity are assured by the way ELECTRUNITE Tubing is made. Carefully rolled flat steel is inspected on both sides. Then formed into a cylindrical shape that's electric-resistance welded for uniform strength. The result: Uniform tubes in every dimension, every contour. Send coupon for more facts.



REPUBLIC



World's Widest Range of Standard Steels

The metal that protects
the most delicate
colors and fabrics

ENDURO

Stainless Steel

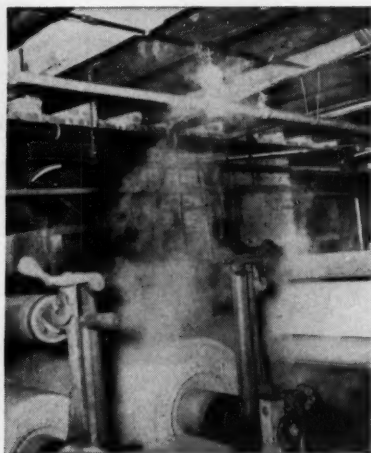
There's no need to worry about color contamination when you use equipment made from Republic ENDURO Stainless Steel. It's the metal that's safe for the most delicate colors and fabrics.

ENDURO is non-contaminating. It does not react with dye bath chemicals or peroxide bleaches. It stubbornly resists rust and corrosion, eliminating the danger of off-colors caused by metallic oxides. A water rinse quickly restores ENDURO surfaces to sparkling cleanliness and permits fast color changeovers.

ENDURO is solid stainless steel all the way through. There are no applied surfaces to crack, chip, peel or flake—never any danger of snagging sheer fabrics. Even at high temperatures, ENDURO resists scaling.

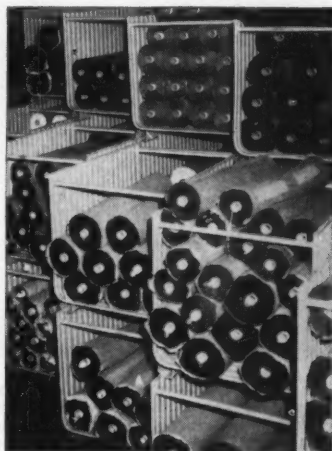
Any slightly higher initial cost of ENDURO equipment is more than offset by years of maintenance-free service.

These are only a few reasons for using ENDURO equipment. Your supplier will give you others about the metal that protects, that cuts costs, that lasts and lasts—Republic ENDURO Stainless Steel. Or write us for more information.



DOUBLE PROTECTION AGAINST STEAM AND FUMES for electrical circuits is provided by the tough, polyethylene coating over the galvanized finish of Republic Dekoron-Coated Electrical Metallic Tubing. Raceways are protected from end to end. Installation is easy. Moisture-tight joints are made, using threadless connectors and couplings. Joints are sealed with vinyl or plastic tape. Dekoron-Coated E.M.T., made by Republic's Steel and Tubes Division, reduces replacement costs. Cuts down-time of costly equipment. Booklet DEK-1 has all the facts. Write for it.

PROTECTION IN STORAGE AND REDUCED HANDLING COSTS are the results of the special units developed by Republic's Pressed Steel Division for a dye company. "In the gray" bolts of cloth are received from customers, then dyed, bleached or printed and stored for indefinite periods. Small amounts are parceled out as the customers request them. The problem of handling, transporting and storing the cloth is greatly reduced with Republic's special unit. Open-end construction permits easy access to cloth. Offset channels under unit permit tiering. Four-way entry permits easy handling in restricted spaces. Want more facts? Mail the coupon.



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and Steel Products

REPUBLIC STEEL CORPORATION

3116 East 45th Street, Cleveland 27, Ohio

Please send more information on:

- ☐ ENDURO® Stainless Steel ☐ Dekoron®-Coated E. M. T.
☐ ELECTRUNITE® Steel Tubing ☐ Special Handling Units

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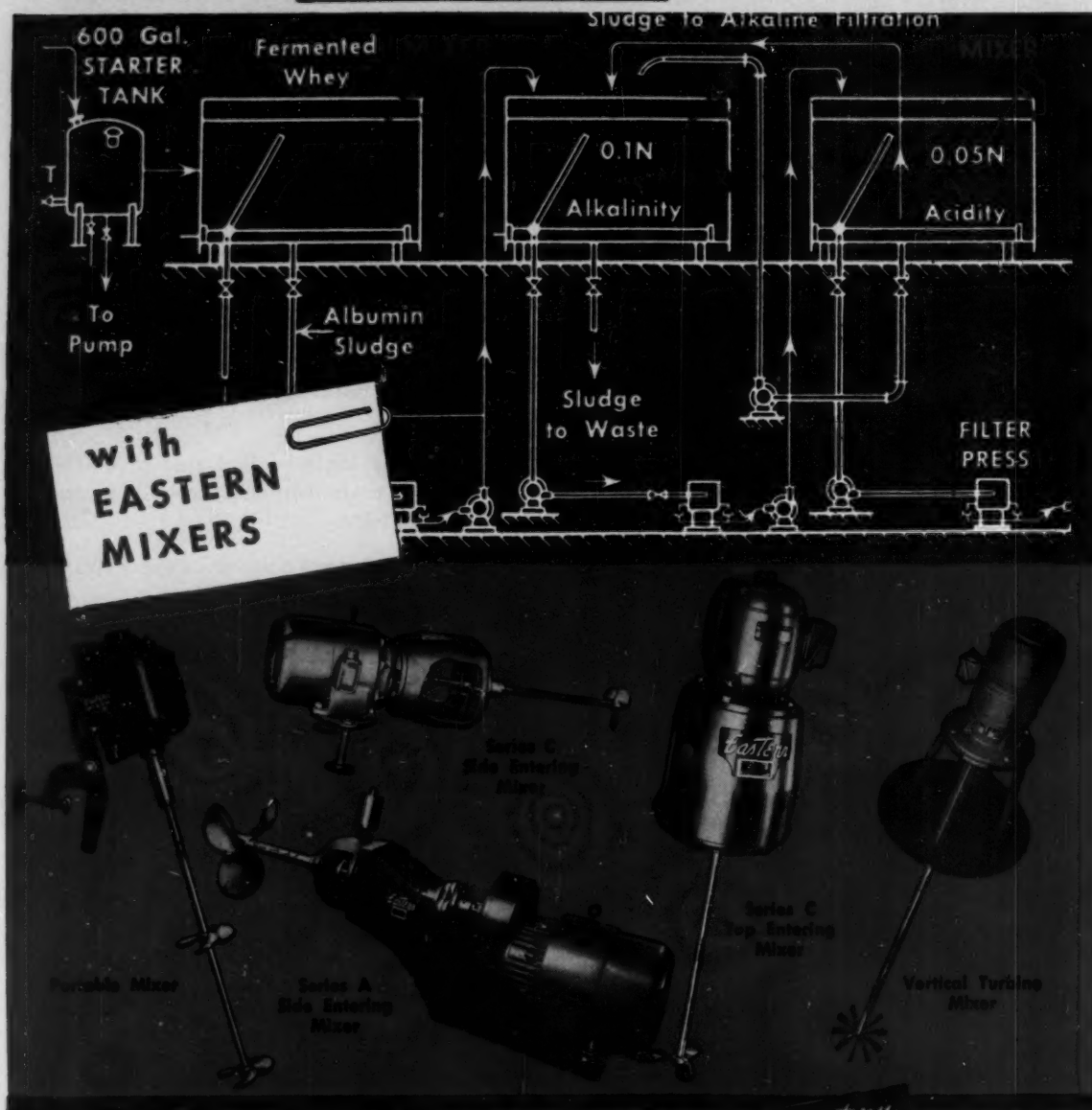
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C-1184

RELIABLE FLUID MIXING in PROCESSING



Eastern's Mixers are designed to meet the needs of today's chemical and industrial processes. Many types are available to satisfy all conditions of fluid consistencies and tank sizes. Selection may be made from a wide range of horsepower, speed, and construction materials. Motors with various voltage ratings and enclosures are also furnished.

PORTABLE MIXERS

Series H at 1725 R.P.M., Series S at 1125 R.P.M., and Series G at 420 R.P.M. are available in motor ratings from 1/20 to 5 H.P. Also available are special speeds, variable speeds, as well as air driven models.

TOP AND SIDE ENTERING

Series A, extra heavy duty for large tanks, are available in side entering units

only within a range of 5-30 H.P. with standard speeds of 280, 420, and 1150 R.P.M.

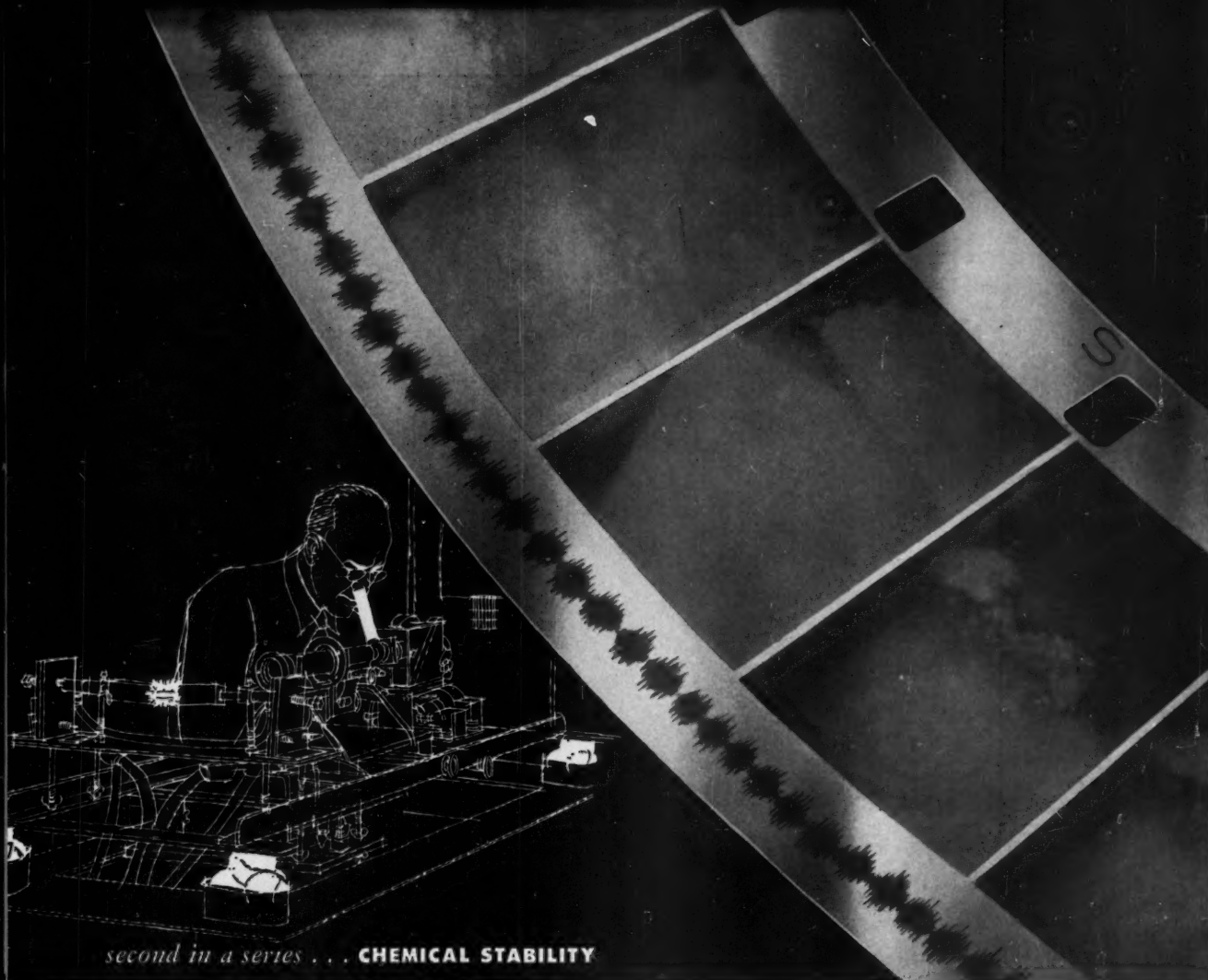
Series C, for average tank capacities, are available in sizes of 1/4 to 10 H.P. at these standard speeds: 1725 R.P.M. (up to 5 H.P.); 1140 R.P.M. (up to 10 H.P.); 420 R.P.M. (up to 7 1/2 H.P.); 280 R.P.M. (up to 5 H.P.). Available in both horizontal and vertical models.

TURBINE MIXERS

Eastern's Top and Bottom Entering Turbine Mixers find particular application where liquid blending requires gentle, yet thorough agitation.

Models are available in sizes from 1/4 to 40 H.P. Standard speeds are 56, 68, 84, 100, 125, 155 R.P.M.





Comparative stability of MONOFRAX® fused cast refractory (left) vs. fireclay (right) . . . under attack by molten glass, as viewed through the high tempera-

ture microscope — one of Carborundum's most useful test facilities. (16 mm. frames shown are not consecutive.)

Unusual Properties of Refractory Materials

Chemical stability — Even under high temperature attack by gases, acids, corrosive solutions, molten salts and molten metals — the chemical stability of CARBORUNDUM's super refractories enables them to fill industrial requirements that other refractories are unable to meet. For this reason, they are being used with increasing frequency in critical applications: i.e. as linings in controlled-atmosphere furnaces, in the production of muriatic acid, as radiant tubes, in the submerged combustion of liquids containing free acid — such as mixed chlorides and sulphates of iron, zinc, mercury and tin; in retorts for reducing and refining zinc, melting copper alloys and for hundreds of similar applications.

CARBORUNDUM's laboratories are constantly developing new super refractories to meet specialized application problems. Current research projects include refractory materials for guided missile components, for atomic reactors, and for applications where wear and corrosion are unusually severe.

The forthcoming issue of CARBORUNDUM's new magazine "Refractories" treats the subject "Chemical Stability of Refractories" in detail. Send for your copy today.

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All in the new magazine "Refractories"

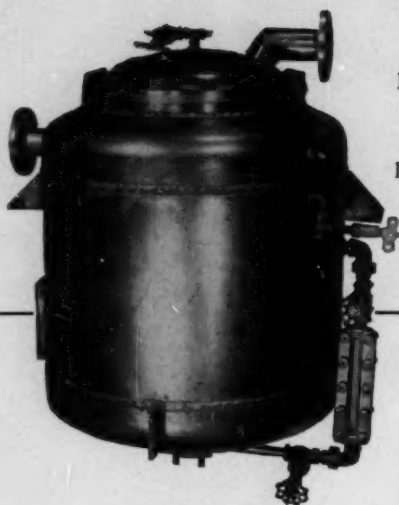
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Dept. H-46, Refractories Division
The Carborundum Company, Perth Amboy, N. J.
Please send me the forthcoming issue of "Refractories".

Name _____ Title _____
Company _____
Street _____
City _____ Zone _____ State _____

Where a drop of water

can be fatal . . .



In freezing temperatures at high altitudes, even a trace of water in the gas can cause engine failure. This Filter/Separator successfully removes the last death-dealing drop. It is a product of Bendix-Skinner Division of Royal Oak, Michigan, contractor to the U. S. Navy. Notice that it is equipped with a Penberthy Liquid Level Gage.

**BENDIX-SKINNER
CHOSE PENBERTHY
LIQUID LEVEL GAGES**

In handling volatile aviation gasoline, two special factors stand out in the selection of gages. They *must* be corrosion-resistant and sparkproof. The Penberthy all-bronze non-magnetic reflex gages used on this installation fill the bill perfectly on both counts. In addition, they offer features found only in Penberthy gages. Features which save time and money on installation and maintenance -- provide long, trouble-free service.

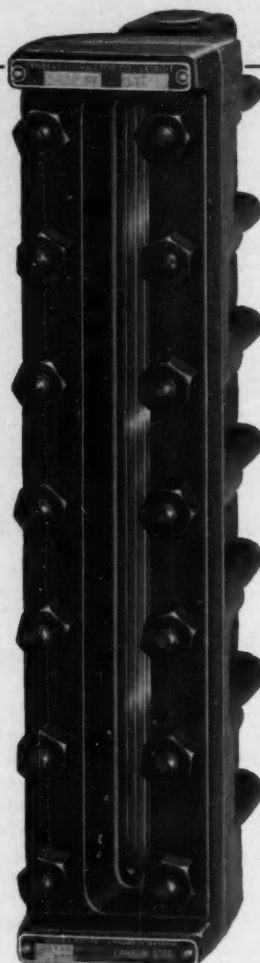
So, whether you order from the standard line or require special designs for specific installations, you are *certain* of satisfaction when you order Penberthy. Write for your copy of Catalog 35.

PENBERTHY INJECTOR COMPANY

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are
preventable!



**U. S. MOTOR
WINDINGS**
*Asbestos-Insulated
to resist burnouts*



**U.S. Electrical
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Eliminate causes and avoid failure

Extensive surveys reveal the astonishing fact that a large percentage of motor burnouts occur from *avoidable* causes such as overload, clogged passages or confined spaces, improper circuit protection and bearing failure. These conditions, if not corrected, result in overheating of the windings. Ordinary insulations are organic and will carbonize when excessively heated, resulting in motor burnout.

As a means of increasing motor life and to resist burnouts the windings in U. S. motors are insulated with inorganic *asbestos*, greatest of heat-resisting elements and Nature's only incombustible fiber.

Asbestos is used in sheet form to separate the windings and in a compounded form, vibro-applied, as a filler to completely isolate each wire. Coil ends are further protected with a built up armor of several coatings of an asbestic compound that smooths the surface and forms an impervious protection against moisture.

In Bulletins portraying the outstanding features of U.S. Uniclosed, Varidrive, Syncrogear and Totally-Enclosed motors, the application of asbestos is interestingly presented, proving its life-lengthening characteristics. Get these Bulletins. Mail the Coupon.



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Now — continuous, accurate control of electrically heated equipment

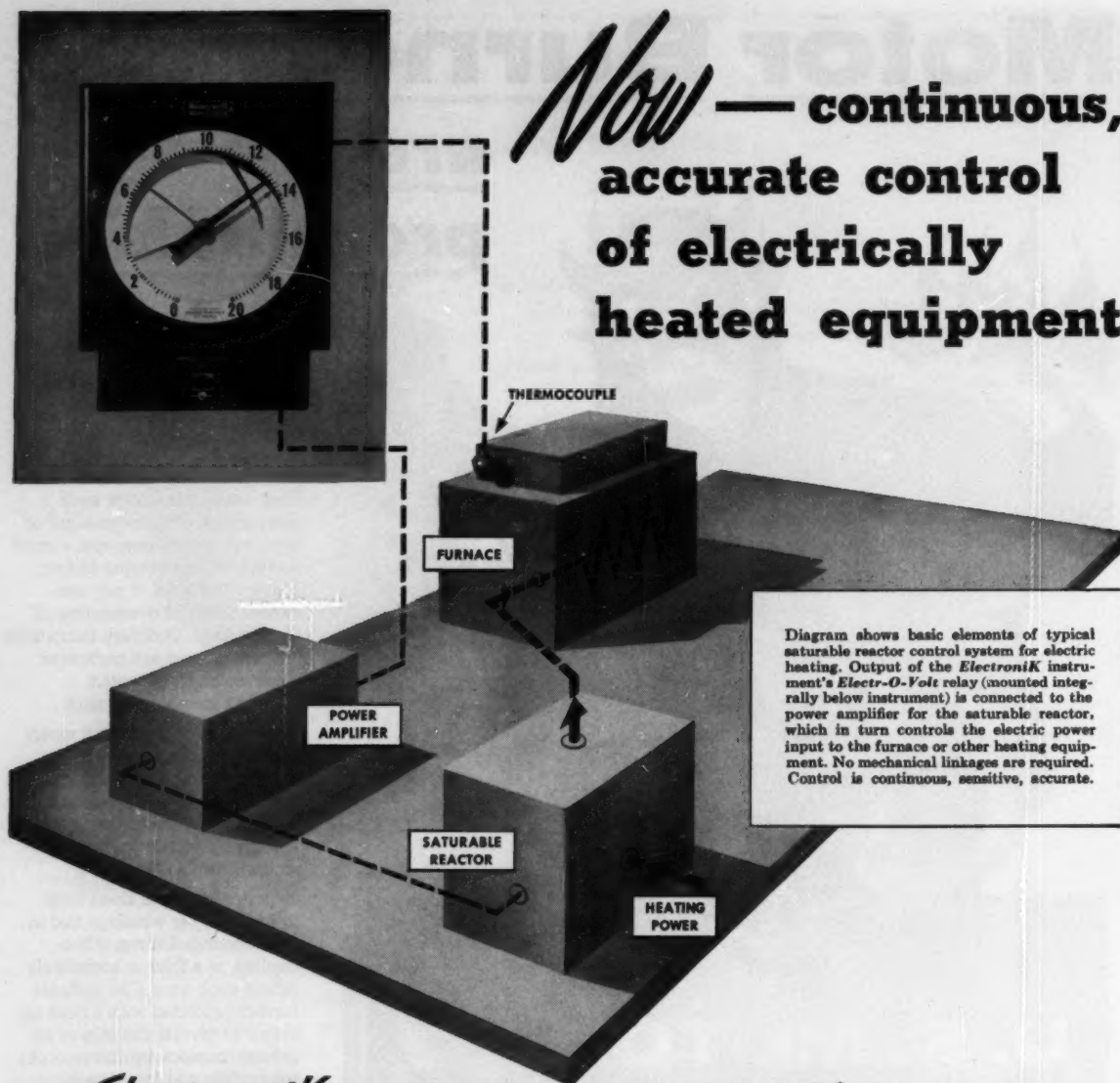


Diagram shows basic elements of typical saturable reactor control system for electric heating. Output of the *ElectroniK* instrument's *Electr-O-Volt* relay (mounted integrally below instrument) is connected to the power amplifier for the saturable reactor, which in turn controls the electric power input to the furnace or other heating equipment. No mechanical linkages are required. Control is continuous, sensitive, accurate.

ElectroniK instrumentation with *Electr-O-Volt** relay provides continuous throttling in saturable reactor control systems

You can now regulate temperatures of electrically heated furnaces, ovens, and similar processing equipment within exceptionally close tolerances, by using an advanced *ElectroniK* control system in conjunction with saturable reactors. This type of control eliminates the abrupt surges of power and the expense of contact replacement which are frequently objectionable factors of on-off or pulsed electric control.

Continuous control. The *Electr-O-Volt* relay, actuated by the *ElectroniK* instrument, provides continuously variable

control input to the saturable reactor power amplifier. This arrangement gives true proportional-plus-reset control action, which adjusts heat input to compensate for size of load, ambient temperature and other variations in heat demand.

Completely electronic. The system has no mechanical linkages, contactors, or other complex moving parts. Its high speed and sensitivity give the precise control required by modern processes.

Broad range of use. *ElectroniK* control

for saturable reactors is applicable to high-temperature heat-treating furnaces, reaction vessels and other electrically heated equipment. It makes possible smooth, finely-adjusted regulation of electric power at high efficiency.

For a discussion of how you can use this control, call your local Honeywell sales engineer... he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., Industrial Division, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

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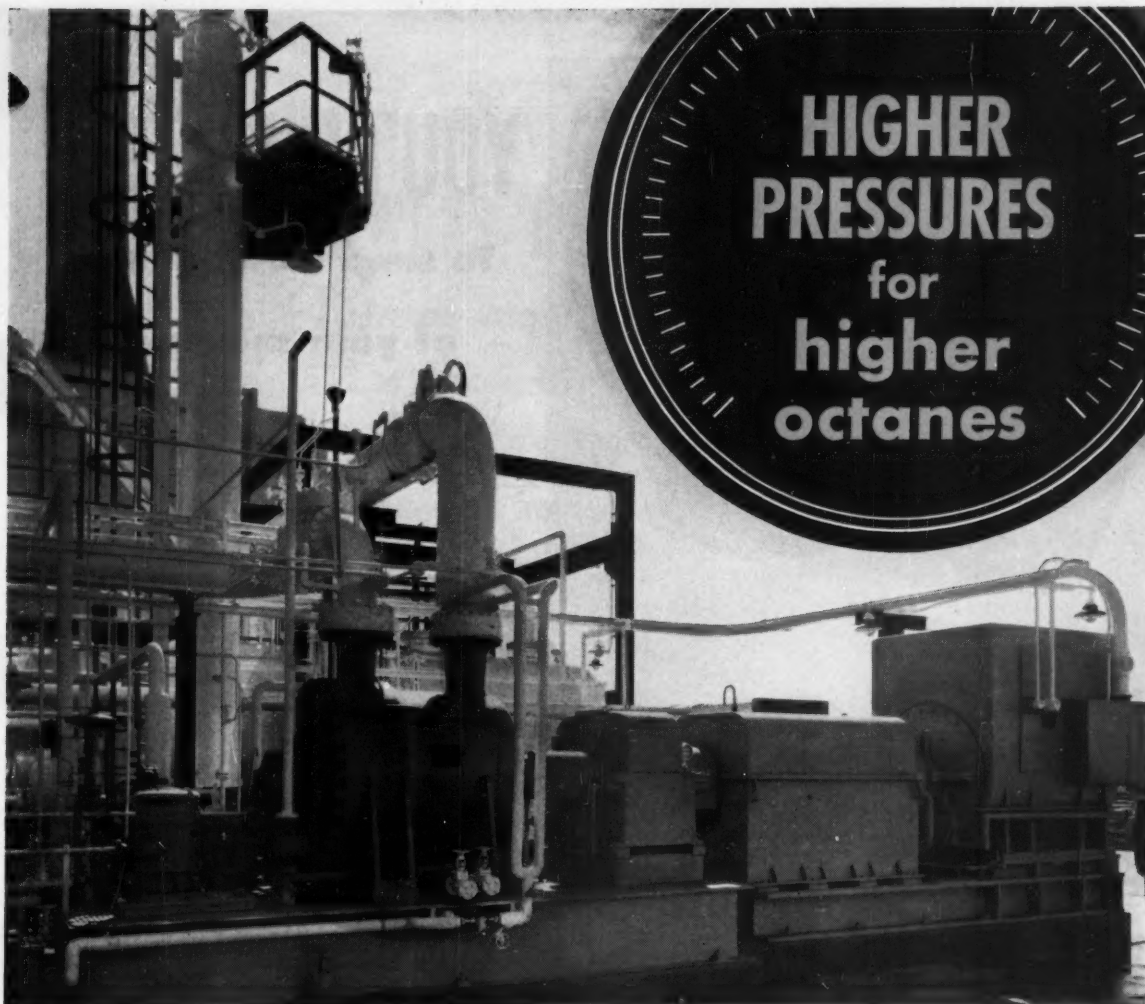
● REFERENCE DATA:

Write for Catalog 1531,
"ElectroniK Controllers,"
and for new Bulletin 8420,
"Electr-O-Volt Relay."



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Honeywell
BROWN INSTRUMENTS

First in Controls



There's no refinery compression job today that can't benefit from the proved economy and dependable performance of modern I-R compressors — available in types and sizes to meet every process requirement. Your I-R representative will be glad to help you work out the best solution to your particular problems.

I-R compressor design keeps pace with latest advances in refining technology at Union Oil Company

In the new catalytic reforming processes for production of high octane gasoline, large volumes of low-density hydrocarbon gas must be compressed to pressure levels of up to 700 psig. These difficult requirements are easily met with Ingersoll-Rand multi-stage centrifugal compressors of the "barrel" or double-case design, as shown above.

For instance, in catalytic reforming service at the Union Oil Company's Oleum refinery, the above I-R centrifugal unit compresses 2670 cfm of 85% hydrogen gas from 473 psia to 669 psia. This 6-stage, double-case compressor, with pressurized oil shaft seals, is driven by a 3500 hp, 1750 rpm motor through a 4.55-to-1 speed increasing gear. Outer barrel is of forged steel and the removable inner casing is horizontally split to permit inspection or removal of the rotor.

12-291



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COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

CHEMICAL ENGINEERING—April 1956

377



In fully-staffed, modern laboratory, miniature equipment is used to test small batches sent to Link-Belt.

Full-scale facilities are used for large runs. Over 1000 of these tests have been made, on more than 100 products.

We'll work out drying, cooling or roasting procedures for you

WHAT's the best drying, cooling or roasting method for processing your materials? Hundreds of plants throughout the world have found an exact, detailed answer through Link-Belt test runs. Here's how it works:

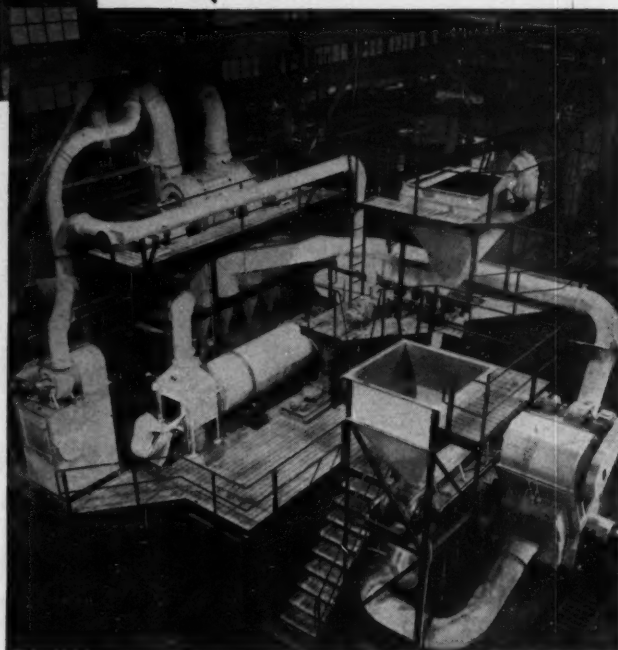
- You send a representative sample of your product — a pound or a ton — with a complete description . . . covering initial moisture, critical temperatures and your merchandising objectives.
- On equipment like that shown above, our specialists conduct test-runs — find how to blend, compound or convert it to desired chemical composition. Our analytical laboratory will determine needed catalyst or agents to be added, if tests so indicate.
- With probable efficiencies decided, we'll lay out flow charts of methods you can follow in your own plant.

If shipping your product is impractical, we'll gladly set up a pilot unit on loan at your plant. Write or send samples to **LINK-BELT COMPANY, 300 West Pershing Road, Chicago, Ill.**

YOU'RE INVITED

**to send us a sample
of your material**

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LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13792

MANY MODELS TO CHOOSE FROM

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10 and 20V with hydraulic lift.
For big-volume production, 80"
high, 10-30 HP.



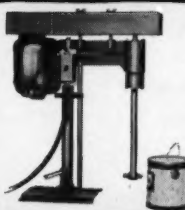
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200—Tank Type. Standard
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For 5 to 80 gallon batches.
Width 4 1/4". Max. tilt will
accommodate 46" tank.



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For testing, pilot plants and
small batches. Results iden-
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NEW improved models of COWLES DISSOLVERS

give you ultimate dispersion

2 to 20 times faster than ordinary

machines—in a fraction of the

space—at a fraction of the cost

*Let us prove it in your
plant...at our risk!*

Here are typical examples from the complete new line of Cowles Dissolvers. They feature many improvements that make them better than ever before. If you are using bulky, slow, conventional equipment, the proper Cowles equipment for your needs will give you increased speed, greater volume and higher quality end products—plus savings in cost—that will amaze you.

We are so sure of its many advantages we want to demonstrate them to you—with the actual equipment, in your own plant, on your own products—without obligation to purchase.

Applicable to viscosities up to and in excess of 50,000 centipoises, they impart high velocity to material at a speed of 3600 to 6000 f.p.m. at the periphery of the impeller. Zones of intense turbulence are created, producing extreme shear and impact. After turbulence, flow becomes laminar, dividing at vessel wall to assure complete circulation of the entire batch. This action breaks down solids to ultimate dry particle size, exposes greatest possible area of reactants to each other, and surrounds each particle with a film of liquid.

The new models require less head room, include patented impellers for processing a wide variety of products, and many other refinements for ease of operation and maintenance. If milling is required following mixing, teaming up Cowles Dissolvers with Morehouse Mills will produce products of finest quality at rates that are nothing less than spectacular.

A trial will convince you that this equipment will give you greater production, of higher quality, at less cost—all over results that mean you can—

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You can make such a trial in your plant at our risk. Write today for complete details—

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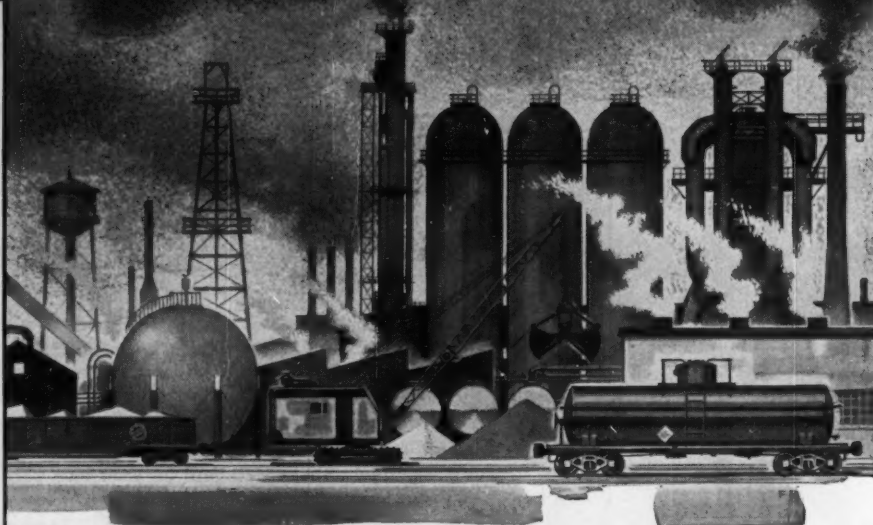
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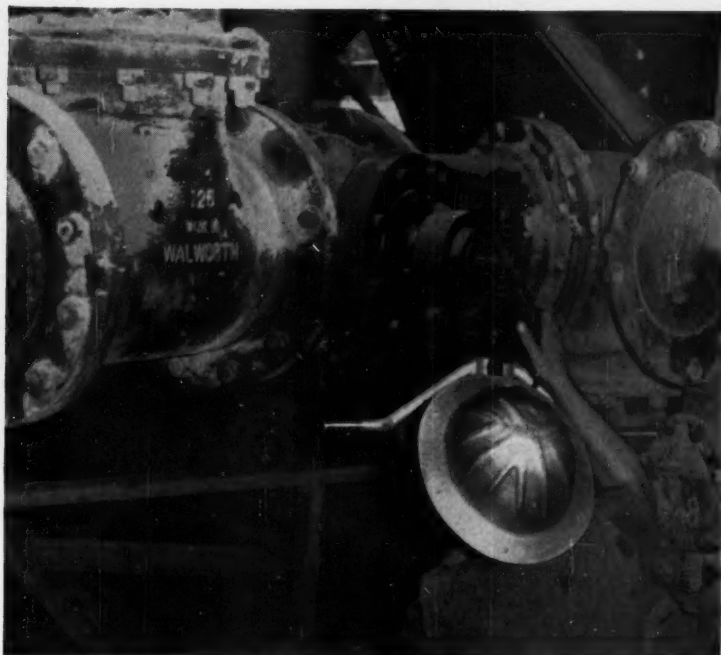
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April 1956—CHEMICAL ENGINEERING



CEMENT: Lubricating a Walworth Lubricated Plug Valve in a West Coast cement plant.



BEVERAGE: A battery of Walworth Bronze Lubricated Plug Valves installed in the blending department of a distillery.



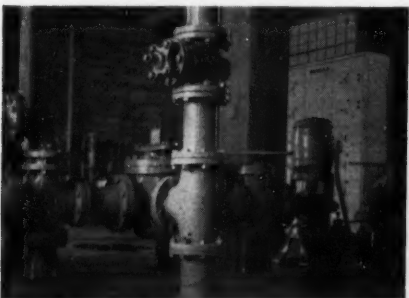
PAINT: Eighteen Walworth Lubricated Plug Valves in a common manifold installation in the varnish division of a midwestern paint and varnish works.

serving almost any industry you can name . . .

WALWORTH LUBRICATED PLUG VALVES



FOOD: Walworth Lubricated Plug Valves are included in the piping arrangement in this large midwestern bakery.



PUBLIC UTILITY: Straight-way and three-way Walworth Lubricated Plug Valves installed in a modern West Coast sewage disposal plant.

At one time Walworth Lubricated Plug Valves were considered a "specialty item". Here are some of the features that have led to their employment in a wide range of industries as high quality 'all-purpose' valves:

(1) There are no threaded stems or complicated seating mechanisms. (2) Because the plug is always seated in the body, solid matter, which might be in the line contents, cannot wedge between the seating surfaces and prevent a tight closure. (3) The position of the wrench handle, or the marking on the plug shank, or the stop collar, clearly indicate the position of the plug. The operator can see from a considerable distance whether the valve is open or closed. (4) Quick opening and closing of the valve is assured by only a quarter turn of the plug. (5) Lubricant can be renewed while the valve is in service.

Walworth manufactures complete lines of Lubricated Plug Valves in a variety of types and materials for working pressures up to 5000 psi and for vacuum services. Sizes range from $\frac{1}{2}$ to 30 inches.

See your Walworth Distributor or write to Walworth for complete information.

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• Here is a new Carpenter service to help processing plants cut piping costs for handling a wide variety of corrosives under moderate operating temperature and pressure conditions. Carpenter PVC Plastic Pipe and Fittings are admirably suited for such piping requirements because of the excellent corrosion resistance, strength and other desirable properties of the unplasticized polyvinyl chloride from which they are made. They withstand both oxidizing and reducing conditions. For this reason, Carpenter PVC Pipe and Fittings supplement other corrosion-resistant piping materials previously made available by Carpenter research and production advances in stainless and specialty steels.

Two types of Carpenter PVC Pipe and Fittings are available—No. 1 provides outstanding chemical resistance along with high strength, toughness and rigidity. No. 2 provides high impact strength and excellent corrosion resistance. Both types are available in eight pipe sizes of $\frac{1}{2}$ " to 4". Pipe is made in Schedules 40 and 80. A full line of Schedule 80 threaded and socket fittings is available.

Easily and economically installed with usual piping tools, Carpenter PVC Pipe and Fittings assure trouble-free service with cost economy. Why not look into the advantages of using Carpenter PVC piping systems in your plant? Consult your nearby Carpenter Distributor or Representative and ask for new Technical Bulletin T.D. 119.

MEMBER



**The Carpenter Steel Company,
Alloy Tube Division, Union, N. J.**

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"

Carpenter



PVC Pipe and Fittings

MIGHTY...SAFE!

Navy adopts Cellulube* fire resistant hydraulic fluids to safeguard aircraft elevator systems

To minimize danger from fires and explosions that might hamper the operational efficiency of its great carriers, the U. S. Navy is now using Celanese* Cellulube 220, a straight chemical compound, as hydraulic fluid to activate deck-edge elevators.

Used for more than 1,500 hours aboard the Bennington, Shangri-La and Ticonderoga, Cellulube 220 is in service aboard the new Saratoga, and is also being evaluated for additional Naval applications.

Cellulube 220 is one of a series of synthetic (non-petroleum) functional fluids developed for industry by Celanese in six controlled viscosities. These fire-resistant hydraulic fluids and cylinder lubricants provide a sig-

nificant margin of safety wherever high temperatures and pressures may cause fire or explosion.

For additional information about the Celanese Cellulube series, write to Celanese Corporation of America, Chemical Division, Department 553D, 180 Madison Avenue, New York 16.

In Canada, Canadian Chemical Company, Ltd., Montreal, Toronto, Vancouver.

DECK EDGE ELEVATOR TAKES PLANE TOPSIDE. Cellulube 220 is being used in elevators of this type on the Shangri-La, Bennington and Ticonderoga. The Navy plans to install fire-resistant hydraulic fluids on all carriers.



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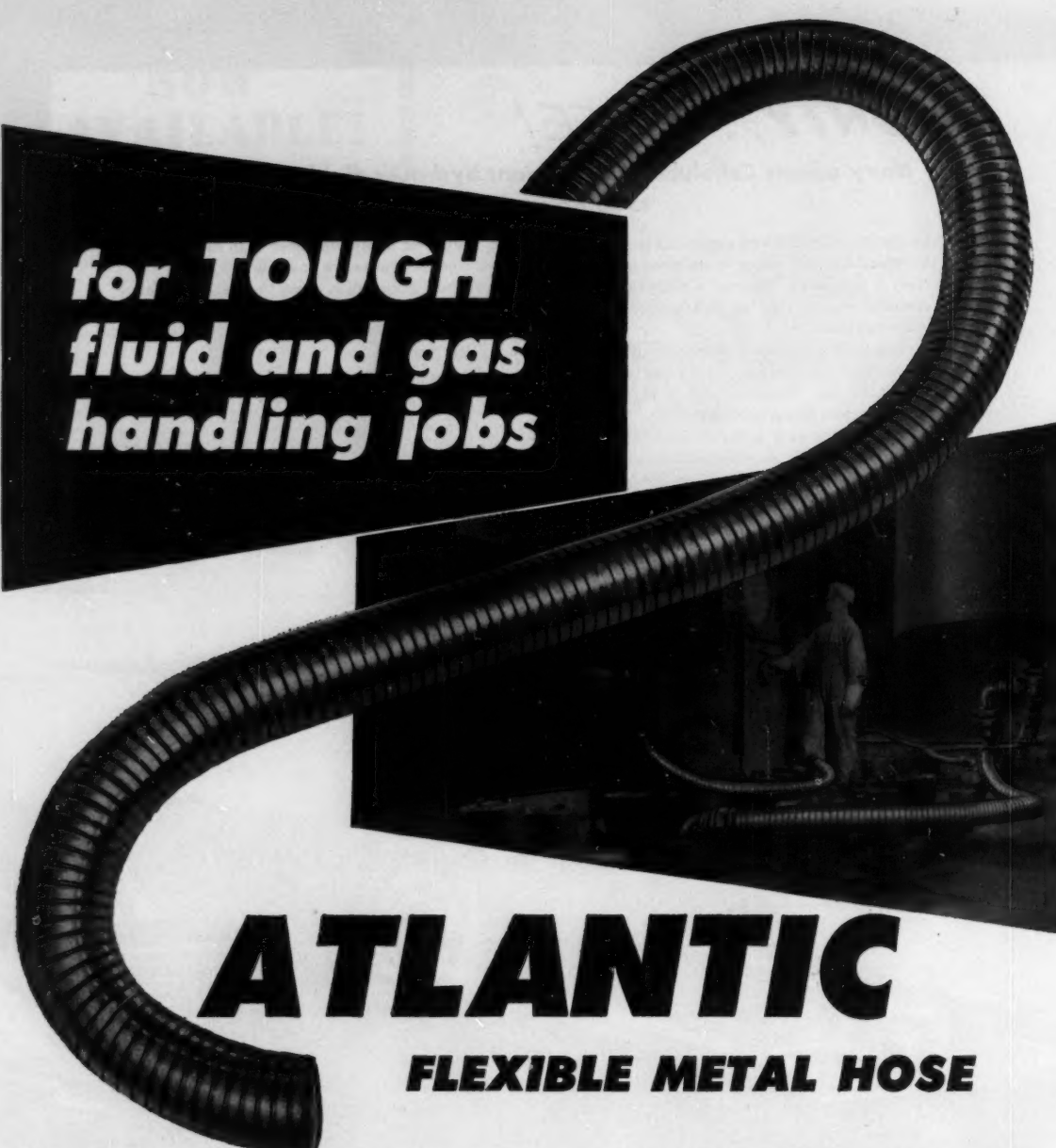
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handling jobs**

ATLANTIC

FLEXIBLE METAL HOSE

Conveying nitric acid for use in batch nitrations is quick death for ordinary flexible metal hose. Sulphuric acid and plating solutions are other notorious killers. When temperature and pressure extremes and adverse handling conditions are also involved, hose replacement is frequent and expensive.

That's why—for tough jobs—it's good economy to specify Atlantic flexible metal process hose. Manufactured to survive the most destructive use, it is unequalled for leak-proof qualities, flexibility, durability, strength and lightness. It performs long after ordinary hose is scrapped and returns real savings in your material and labor dollar.

Whatever your application — conveying, controlling movement and vibration, correcting misalignments, compensating for expansion and contraction — there is an Atlantic flexible metal hose that is best for it.

Available in Seamless or Interlocking construction: Steel, stainless steel, monel, bronze. 1/4"–36" I.D. inclusive with appropriate fittings.

Our engineers have developed flexible metal hose for a number of classified nuclear applications. Though these types cannot be released at present, the experience gained is available for any unusual problems you may have.

Write for Chemical and Process Industries Bulletin 20D.

See our Catalogs in Sweet's Files for
Product Designers
and Mechanical Industries.



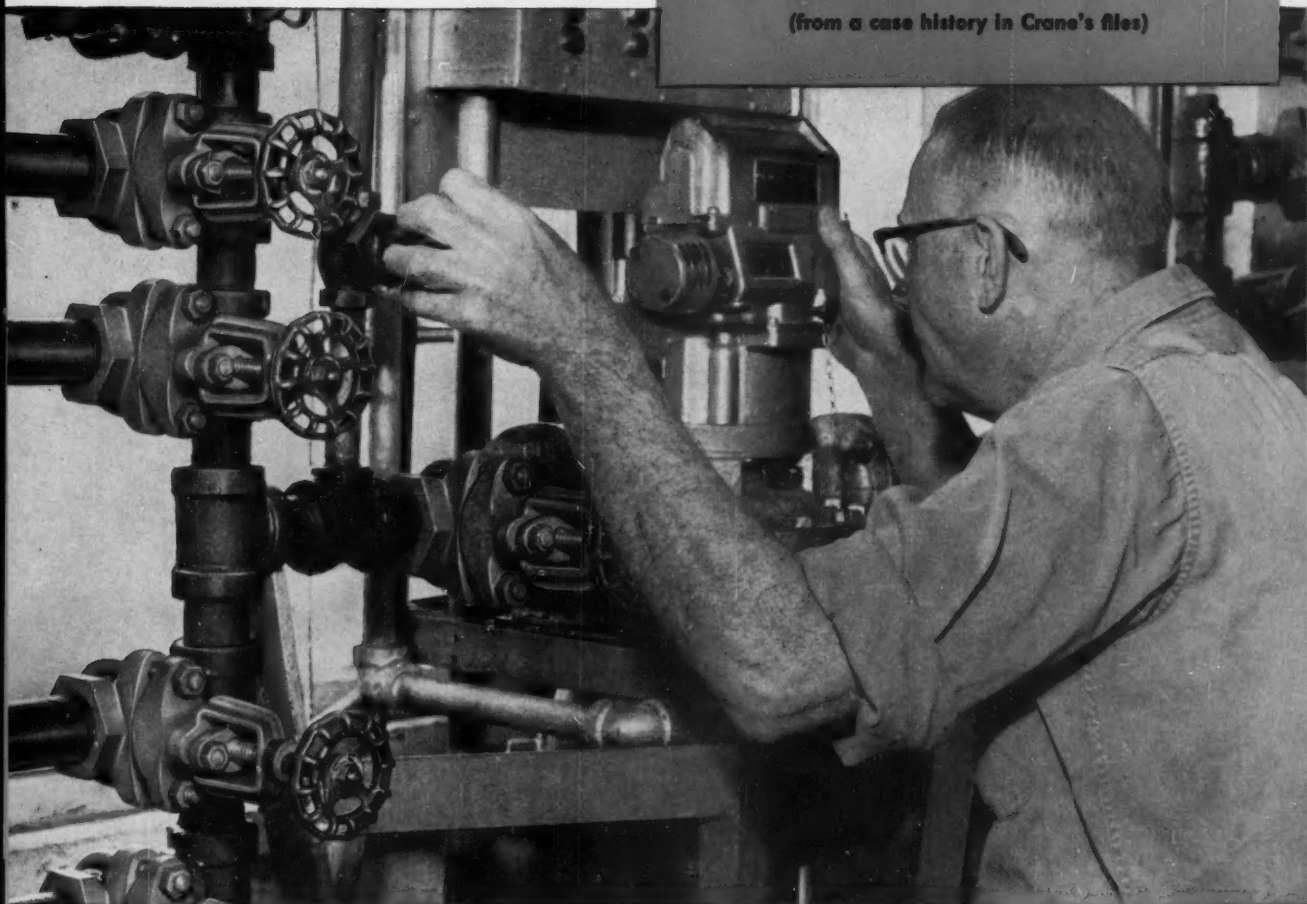
ATLANTIC

ATLANTIC METAL HOSE CO., INC.
329 Dyckman St., New York 34, N. Y.



INTERESTING FACTS ON VALVE PERFORMANCE

(from a case history in Crane's files)



Ni-Resist valves prove low-cost solution to soap oils and fatty acids leakage problem

The installation: At Davies-Young Soap Co., Dayton, maker of various-type soaps and cleaning fluids.

The plant was having trouble with leakage through valve seats in the raw materials supply lines. Unwanted materials leaking past metering stations would infiltrate processing vats and spoil product batches.

Four different makes of valves were tried before the trouble was stopped. With all four, seat leakage developed quickly—the valves lasted no more than four to eight weeks. Valve replacement costs were a factor on top of production losses.

The condition was remedied when Crane No. 1670 Ni-Resist cast iron gate valves were installed. Eighteen months later—with no maintenance or

replacements required—the Crane valves are still holding tight. They show no deteriorating effects from the fluids handled.

Crane Ni-Resist gates don't look much different from similar valves of other makes. Their difference is mainly internal—in properly designed, accurately finished seating of Crane 18-8 SMO stainless steel . . . and in the added corrosion-erosion resistance of Ni-Resist bodies and bonnets as cast by Crane.

It's a matter of record—on many hard-to-hold, mildly corrosive fluids, these valves have no equal. Moderate price makes them an outstanding value where highest quality iron valves are needed.

Talk it over with your local Crane Representative or write to address below.



CRANE VALVES & FITTINGS
PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

More Facts on These Better
Iron Valves—See Over

Most economical for many process services

CRANE NI-RESIST Cast Iron Gate Valves

with Crane 18-8 SMO Stainless Trim

These valves have a universal reputation for extending the utility and economy of cast iron for chemical process piping. Their fine combination of Crane-cast Ni-Resist body and bonnet, and Crane 18-8 SMO seating is further enhanced for corrosive-erosive service by Crane quality manufacture in every detail.

Low first cost and user-proven low maintenance cost make Ni-Resist valves an outstanding value in all suitable applications. No valve was ever more deserving of thorough trial... thousands of steady users in all industries vouch for it.

Typical Successful Applications

Crane Ni-Resist gates are used widely in soda and sulfate pulp mills... in creosote lines in wood treating... on sour distillates and crude oils in petroleum refining... and for many similar process services.

Users report a much longer service life over ordinary cast iron on highly volatile liquids, corrosive vapors and gases; on salt, chloride, sulfate and alkaline solutions; on sea water and brine, and also on certain acids.

Construction Features

From handwheel to body, all parts of these outside screw and yoke valves are carefully proportioned to give durable, smooth and positive operation. They have no excess weight, yet have ample strength under line strains. The disc is solid wedge with a strong, non-rigid T-head stem-disc connection. A deep packing chamber assures long-lasting stem seal.

Sizes up to 3 in. have a clamp-type bonnet joint that allows quick and easy dis-assembly—ideal on services needing frequent valve cleanout. Larger sizes have multiple bolted bonnet joint.

Wide Selection for Your Needs

Screwed end valves come in sizes $\frac{1}{4}$ to 2 in. incl. Flanged end patterns with clamp-type bonnet joint, in sizes 1 to 3 in. inclusive.

Flanged end valves with bolted flange bonnet joint are made in 4-, 6-, and 8-in. sizes. These valves in 10 and 12-in. sizes are available on special order. Prices and dimensional data supplied on request.

Get This Specification Data

This folder gives you complete up-to-date information on Crane Ni-Resist that helps you reduce valve costs and piping maintenance. Contains all the data you need to make a selection. Get a copy from your local Crane Representative, or write Crane Co., Chicago 5, Ill.

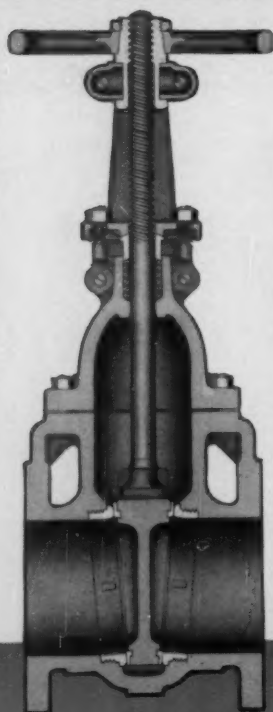


WORKING PRESSURES

Screwed End Valves: 225 Pounds; water, oil or gas; non-shock
Flanged End Valves: 200 Pounds; water, oil or gas; non-shock

NI-RESIST PROPERTIES

Ni-Resist is a superior nickel bearing alloy cast iron. Although its physical properties are equal to those of regular cast iron, Ni-Resist offers substantially greater resistance to corrosion, erosion and wear. Crane Ni-Resist valve castings are marked "NR."



Cross section, 4-, 6- and 8-in. sizes, bolted bonnet and flanged ends only —No. 1671

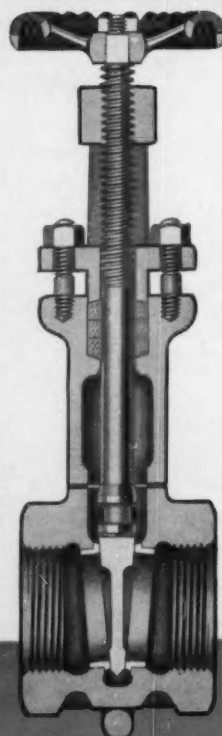
(10 and 12 in. sizes available on special order)

No. 1671, 4 in. and larger



Cross section, 3-in. and smaller with clamp-type bonnet joint. With screwed ends, sizes $\frac{1}{2}$ to 2 in.—No. 1670

No. 1671, 1- to 3-in. sizes



All Valves Are Air-Tested



DARCO Digest

CHEMICALS DIVISION, ATLAS POWDER COMPANY, WILMINGTON 99, DELAWARE

• Atlas Powder Company, Canada, Ltd., Brantford, Ontario, Canada

Purifying liquid products by adsorption

Many liquid or liquefiable products require purification before they are processed to the finished stage. Typical of these are such things as plasticizers, solvents, alcohols, vegetable oils, fats, and waxes.

Adsorption by activated carbon often fits into the methods of processing such liquids. Usual techniques for removing gross impurities, by distillation, solvent extraction or similar methods, frequently require the added touch of adsorption to bring impurity levels to the desired point.

When purifying liquid products, consider adsorption in two principal instances:

1 When gross methods of purification leave residual impurities that cannot be removed by other methods. The carbon adsorption process is especially efficient and economical when dealing with low levels of impurities.

2 When original level of impurities is so low that initial treatment by gross methods is uneconomical. As a rule of thumb, adsorption proves practical at impurity levels below 2 or 3 per cent. In comparison to gross methods, adsorption requires only simple equipment, far less energy input, and considerably less loss of product.

Another characteristic of adsorption—it's extremely versatile. We've helped many people to apply it to removal of colors, odor bodies, complex molecules, surface active agents and other impurities that are held to the carbon adsorptive surface. Let's talk over your specific problem and see how DARCO activated carbon may be able to help.



Darco Saves Valuable Product

When purifying products that have comparatively high cost per pound, it is important to consider retention when you choose an activated carbon.

All carbons hold back some liquid in the filter cake. The amount of product lost this way, however, will vary considerably with the carbon.

DARCO activated carbon is notable for its low retention. When purifying vegetable oils, for example, up to 90 pounds more oil per 100 pounds of carbon are recovered when you use DARCO. Similar savings are possible with other types of filtrates.

IMAGINEERING with activated carbon

Consider for a moment the basic nature of adsorption . . . and you may come up with some unique ideas about what it can do. Adsorption may be defined as occurring when there is a greater concentration of solute at a liquid-solid interface than there is in the main body of the solution. In other words, when you put activated carbon in a solution, *concentration increases* on the adsorptive surface . . . the material concentrated being the stuff that is being adsorbed.

How could this characteristic of increasing concentration be used—apart from the usual purposes of removing impurities?

Here's a possibility. Suppose you have a chemical reaction that you want to take place, but the reactants are both in dilute concentrations. Because of the Law of Mass Action, the rate of reaction is bound to be slow. If you'd like the reaction to speed up, you could do it by increasing concentrations. Maybe adsorption could do the trick. If the materials you're working with are of the type that are adsorbed on activated carbon, it might be worth trying . . . just add some carbon and see what happens. It's possible that the increased concentration at the adsorptive surface will get you the reaction characteristics you're after.

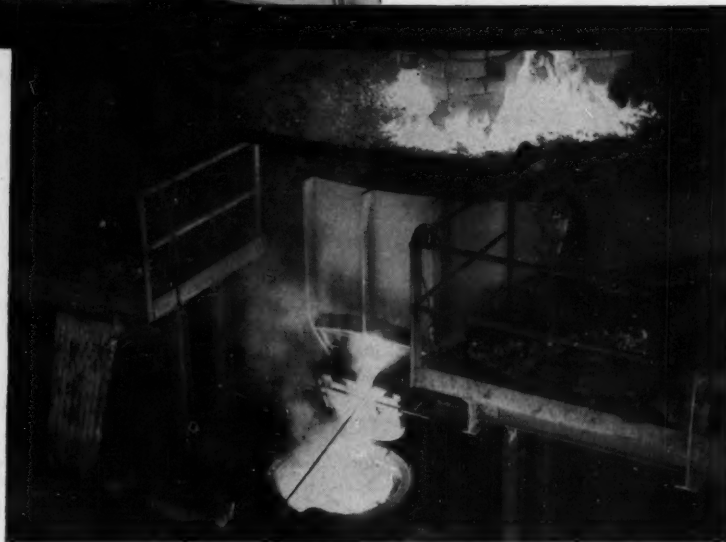
Don't let your imagination be limited when you look at the adsorption process. There's a lot more to it than removal of impurities. This combination of large pore area in a small physical volume has many potentials that bear investigation.

WAYTROLS® feed an inferno with $\pm 0.1\%$ accuracy



A metal producer reports $\pm 0.1\%$ accuracy in proportioning with a pair of Jeffrey WAYTROLS.

Close formulation of the mixture as provided by WAYTROLS is vital to quality production in an electric furnace.



Mix an ore with slagging and reducing agents in the proper proportions. Apply the 3100° heat of an electric arc under carefully controlled conditions. Draw off the molten metal. Basically, that's the electrothermic process so widely employed today.

"Proper proportions" is the keynote to success. Inaccurate proportioning may ruin the entire process. Jeffrey WAYTROLS (continuous weigh feeders) help avoid that hazard.

WAYTROLS take materials from overhead hoppers and feed them at predetermined quantities or rates; so many ounces, pounds or tons per hour. They do this within the accuracy of the weighing equipment

itself and without dependence upon the attention and judgment of the operator.

Weighing, batching and proportioning systems are described in Catalog 841. For a copy, write The Jeffrey Manufacturing Company, Columbus 16, Ohio.



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Better Things for Better Living
... through Chemistry

CHEMICAL ENGINEERING

PROPERTY AND APPLICATION DATA
ON THESE VERSATILE ENGINEERING MATERIALS:

"ZYTEL," "ALATHON," "TEFLON," "LUCITE."

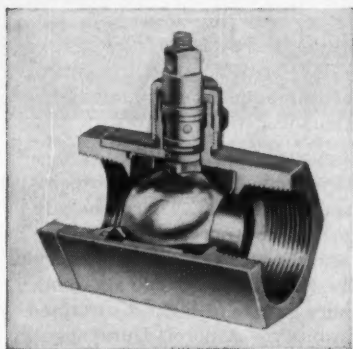
NEWS

Filter unit of Du Pont TEFLON® is compact, lightweight and chemically inert

New dripless sleeve of **ALATHON®** polyethylene resin provides safe handling of chemicals



Sleeves of "Alathon," fitted on the necks of chemical bottles, increase handling safety in the laboratory by eliminating drip during pouring. Keeping the outside of the bottles dry protects hands from acid burns, reduces chances of slipping, and prevents defacing of labels. Resistance to wetting of "Alathon" makes this possible. (Molded by A. L. Hyde Co., Grenloch, New Jersey.)

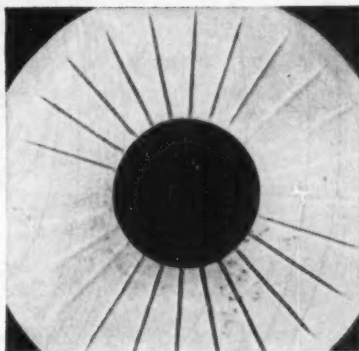
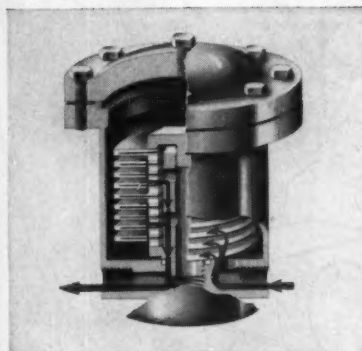


Valve seats of **TEFLON®**

provide tight, long-lasting, chemically inert seals. With seats of "Teflon" these valves are able to handle practically all known fluids and gases—in extreme temperature ranges. They also offer the advantages of economy by reducing maintenance time. (Manufactured by the Jamesbury Corp., Worcester 5, Massachusetts. Processors—Crane Packing Co., Chicago, Illinois, and Fluorocarbon Products Inc., division U. S. Gasket Corp., Camden, New Jersey.)

NEED MORE INFORMATION?

Clip the coupon for additional data on the properties and applications of these Du Pont engineering materials.



Filter disc with vari-depth molded passageways (right). Note both radial and concentric grooves. By a unique welding process, the manufacturer seals the edges of two of these discs with the molded surfaces mated to form a filter segment. These are then stacked on a stainless-steel mandrel with washers of "Teflon" (left). (Manufactured by Porous Plastic Filter Co., Inc., A Pall Filtration Company, Glen Cove, New York.)

Porous "Teflon" tetrafluoroethylene resin is the most modern filtration medium available to industry. Like the solid form, porous "Teflon" is chemically inert, thus providing a filter medium unexcelled for use with all strong acids, all alkalis, oxidants and organic solvents. Even such severe corrosives as fuming nitric acid, hydrofluoric acid, aqua regia, hydrogen peroxides and concentrated caustics are readily filtered with "Teflon."

These filters of porous "Teflon" offer a large filter area in a limited space. (See photographs). Nine 3½" O.D. segments of "Teflon" equal one square foot of filter area. These filters will remove particles of 3 microns in fluid filtration and 0.1 micron in gas filtration. The filters permit a high-capacity flow and re-

quire no gasket. Its extreme toughness and resiliency recommend "Teflon" for use in gaskets, packings and component parts of pumps, agitators, mixers—and for valve seats and discs.

Filters of "Teflon" are often used as polishing filters, following other types. No downstream lint is present in material filtered by porous "Teflon." The non-adhesive quality of "Teflon" enables these filters to be easily cleaned with any solvent, and they can be readily sterilized.

"Teflon" can operate through a temperature range of -450° F. to 500° F. Can you use the unique combination of properties "Teflon" has to offer? Send the coupon below for further information on how "Teflon" can be advantageous in chemical applications.

E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department
Room 254 Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada Limited, P.O. Box 660, Montreal, Quebec

Please send me complete property and application data on Du Pont "Teflon" ☐ and "Alathon" ☐.

I am interested in evaluating these materials for

Name _____

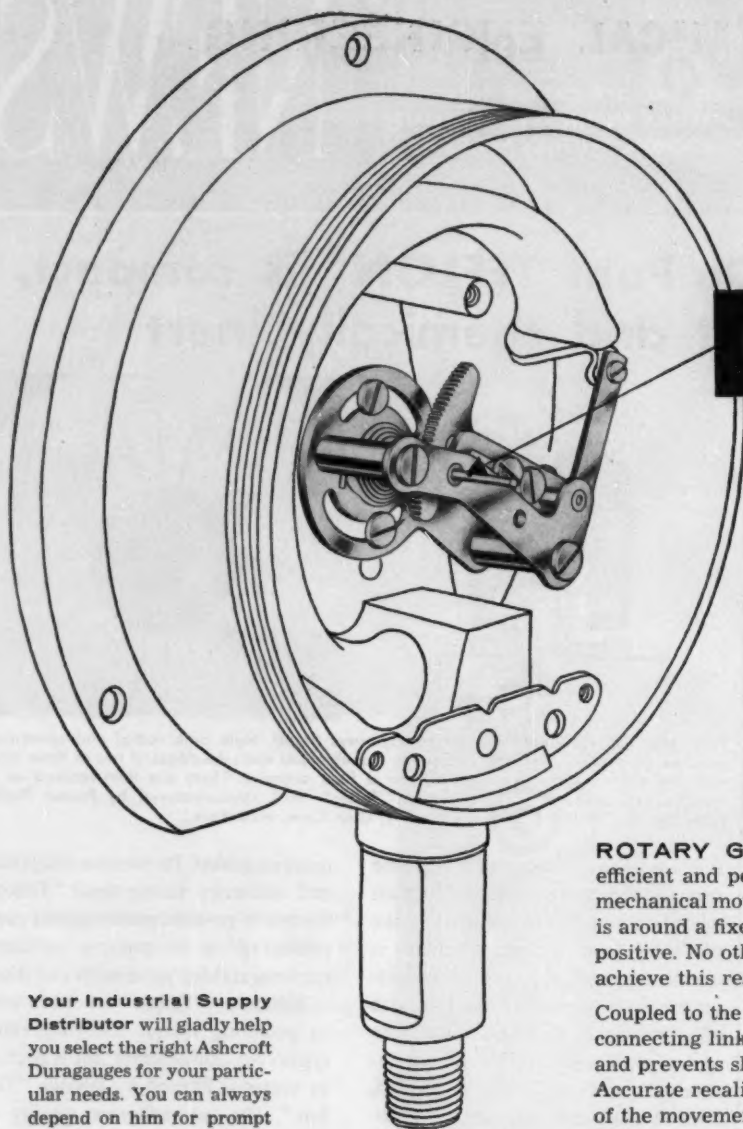
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ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT
MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, Stratford, Conn. 'HANCOCK' VALVES, Watertown, Mass. 'CONSOLIDATED' SAFETY RELIEF VALVES, Tulsa, Oklahoma. AIRCRAFT CONTROL PRODUCTS, Danbury & Stratford, Conn. and Inglewood, Calif. "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, Muskegon, Mich.

Why does
the

MOVEMENT

in the
**ASHCROFT
DURAGAUGE**
outperform all
other types?

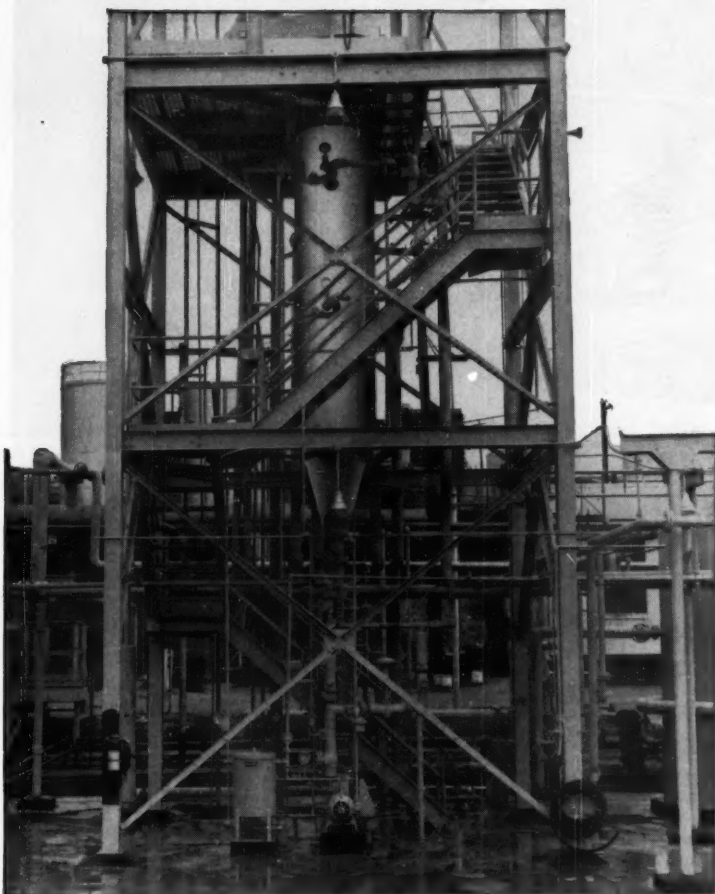
ROTARY GEARED MOTION, the most efficient and perfect method of transmitting mechanical motion ever developed. Because rotation is around a fixed center, pointer position is always positive. No other type of movement can ever achieve this result.

Coupled to the movement is a one-piece connecting link that guarantees correct calibration and prevents slippage or parting under tension. Accurate recalibration is easy from front or rear of the movement. Universal adjustability permits the use of uniformly graduated dials, thereby facilitating maintenance.

The Ashcroft Duragauge is available with all-stainless-steel movement or stainless steel with nylon bearings and pinion gear. There are case designs and materials, Bourdon tube materials, pressure ranges and dial sizes to meet your service conditions exactly. Save time, trouble and money. Specify the pressure gauges of highest sustained accuracy and durability — Ashcroft Duragauges.



SHELL OIL COMPANY solves scaling problem with **Turba-Film Evaporator**



Turba-Film Evaporator used by Shell Oil Company, Martinez, California, dries a special type of oil, eliminates scale formation on heat transfer surfaces and provides continuous operation. The Turba-Film Evaporator shown is a No. 5 model built to Shell's specifications with stainless steel rotor, vapor section and outlet cone. It processes 30 barrels of oil per hour.

The problem:

to reduce moisture content of a special type of oil from an initial content of 3 to 6% to a maximum of 0.2%. Standard stills achieved the specified moisture content but deposited inorganic salts as scale on the heat transfer surfaces in such quantities as to demand frequent shutdown for cleaning.

The solution:

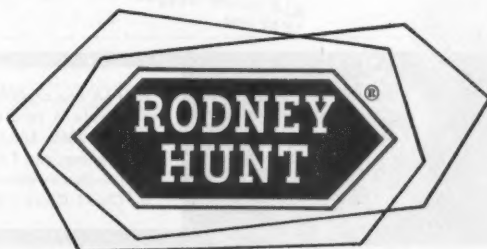
the Turba-Film® Evaporator, now in use for over a year, reduces 30 barrels of oil per hour to the specified moisture content — usually even lower — and precipitates the scale-forming substances in the dried oil, from which they are easily filtered. Shell now enjoys continuous operation in this process without shutdown for cleaning.

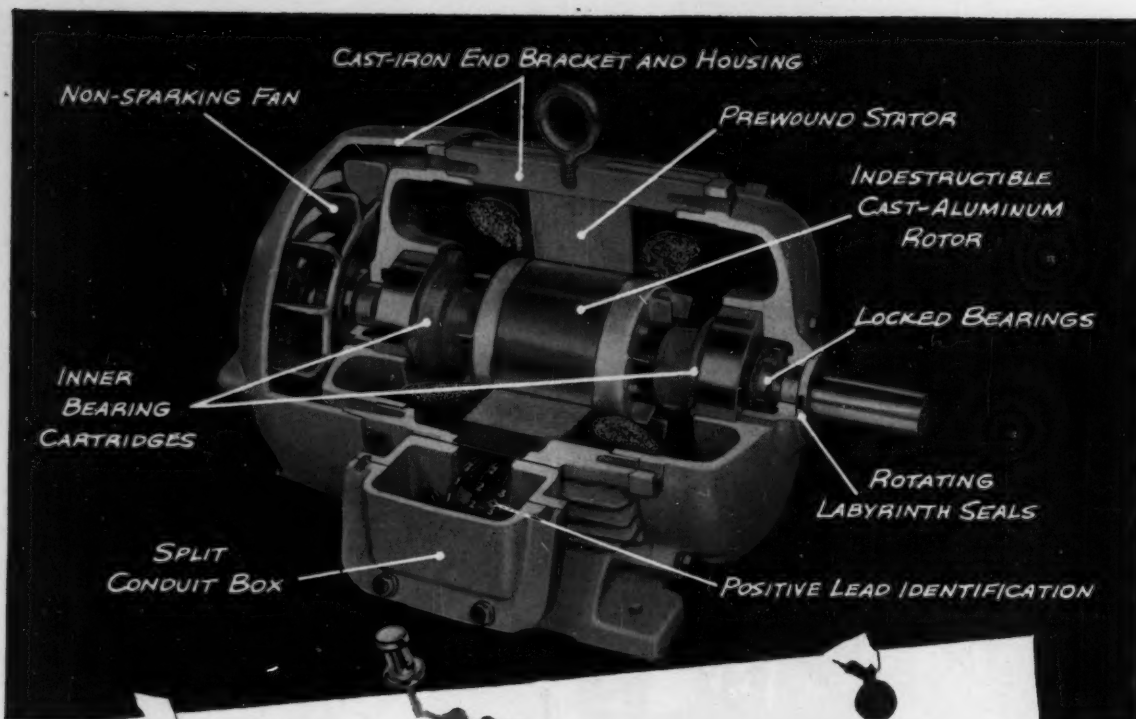
The patented Turba-Film Evaporator and the Rodney Hunt-Luwa Spray Dryer have a broad range of moisture-removal application in the Chemical Process Industries. Send for informative literature on Rodney Hunt process equipment.

RODNEY HUNT MACHINE CO.

Process Equipment Division

31 Vale Street, Orange, Massachusetts, U. S. A.





Are you getting all these extras in the motors you buy?

Louis Allis gives them to you in the new L. A. enclosed and explosion-proof motors

For years, Louis Allis has specialized in special motors for many of industry's toughest drive problems. Such installations call for extreme care in both motor design and manufacture—care that has become a habit with us. We build our enclosed and explosion-proof motors with the same special care.

What does this mean to you? It means that you get a motor with extra features—a motor that runs better, lasts longer. Here are a few of the extra reasons why:

- These new motors carry Underwriters' label for use in four groups of hazardous locations—Class I, Group D, and Class II, Groups E, F, and G. This four-group approval for a single motor simplifies your stocking problem.

- New, exclusive phenolic impregnating varnish provides high thermal and chemical resistance. It remains resilient and resists aging, prolonging the life of the motor.

- Inner bearing cartridges lock bearings to end bracket and form explosion-quenching seal along the shaft. Inner race of bearing locked to shaft, reducing end play—an extra quality feature.

- Rotating labyrinth seals keep dirt and moisture out of the bearings—keep grease in.

There are many other features such as a new diagonally split conduit box, sturdy cast-iron construction, positive lead identification, non-sparking fan. Our new bulletin No. 1700 shows why you get extra value for your dollar in a Louis Allis explosion-proof motor. Write for your copy.

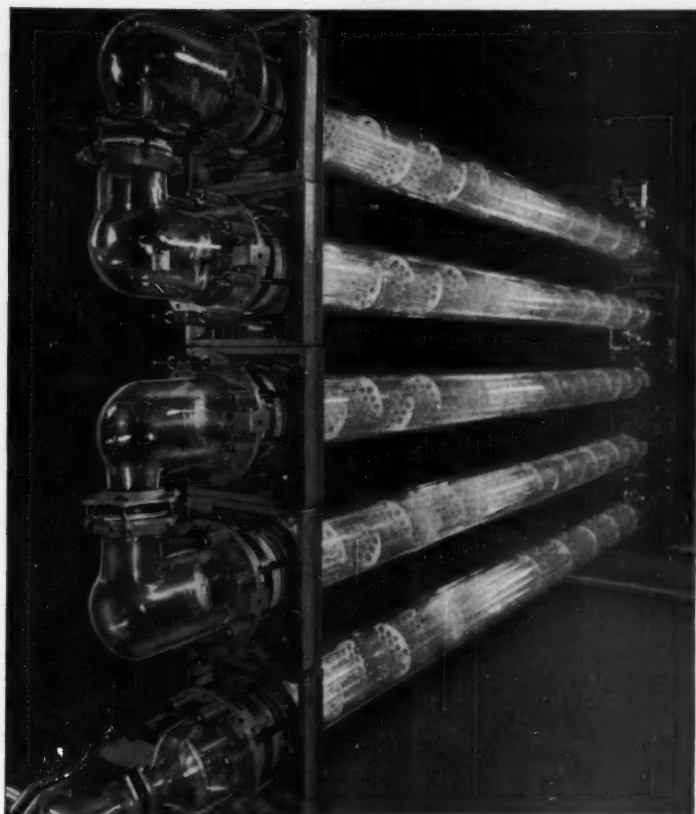


New LA line explosion-proof motors are available in rerated frame sizes 182 through 326U, and in ratings of 1 to 30 hp, 3 phase, and 1 to 5 hp, single phase. Also available with Underwriters' approval for Class I, Group C hazardous locations.



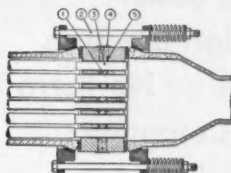
THE LOUIS ALLIS CO.
MILWAUKEE 7, WISCONSIN

EP-102



Now you can get off-the-shelf delivery on corrosion-proof shell and tube heat exchangers. This new type of unit, low in initial cost, costs nearly nothing to maintain.

Header assembly ends floating head, packing gland troubles



The unique "fluid" seal between the shell side and the tube side is effected by a Silastic sealer sheet (1). This acts as a fluid and is put under fluid pressure

by tightening the flange bolts (2). The fluid is completely contained in the cavity formed by the tubes (3) and the retainer ring (4) around the outside of the tube sheets. The Silastic sealer sheet is compressed against the Teflon sealer sheet protector (5), which presses against the precision-finished tube ends, creating a leakproof seal.

Heat, cool and condense corrosive fluids safely in PYREX brand modular shell and tube heat exchangers

Now you can heat, cool and condense corrosives with the same ease you handle noncorrosives.

Because they contact only glass, Teflon and ceramic materials, corrosive fluids can't harm PYREX brand shell and tube heat exchangers. These units are safe, too, for fluids sensitive to metals.

No heat flow barrier

The smooth surface of glass helps keep fluid velocity high. Less stagnant film build up between the fluid and shell on either tube wall. And glass' smooth surface resists scale and algae deposits.

Initial high efficiency stays high permanently.

Wide versatility

The individual shell and tube units are

mass-produced standard modules. You circuit the multiples you need in series, parallel or series-parallel flow combinations. You add units as demand increases or cut capacity with external manifolding when demand is down.

Built to bring you savings

Mass production gives you low first cost and off-the-shelf delivery. Installation costs are low because you need only two men and no hoists or cranes. We supply the mounting brackets, the only supporting framework you need.

You get low maintenance costs because there is no corrosion and no scaling. You clean PYREX brand shell and tubes with dilute HCl or even a detergent rinse, without dismantling. The external metal parts are Monel metal or epoxy coated cast iron.

Two models, two sizes

You can choose the new PYREX brand shell and tube heat exchanger in either 50 sq. ft. or 13½ sq. ft. capacities in standard or regenerative types. The standard model takes corrosives on the tube side only. The regenerative takes corrosives on both tube and shell side.

Design Manual tells all

"Design Manual for PYREX brand Modular Shell and Tube Heat Exchanger Units" is a detailed engineering reference guide. It shows you how to select units, lay out systems, engineer systems and order equipment.

Send the coupon for your copy. Or, if you want answers to specific questions, write Plant Equipment Sales Department, Corning Glass Works, Corning, N. Y.



CORNING GLASS WORKS
Corning, New York

Corning means research in Glass

CORNING GLASS WORKS, 14 Crystal Street, Corning, New York

Please send me a copy of your "Design Manual for PYREX brand Modular Shell and Tube Heat Exchanger Units."

Name.....Title.....

Company.....

Street.....

City.....Zone.....State.....

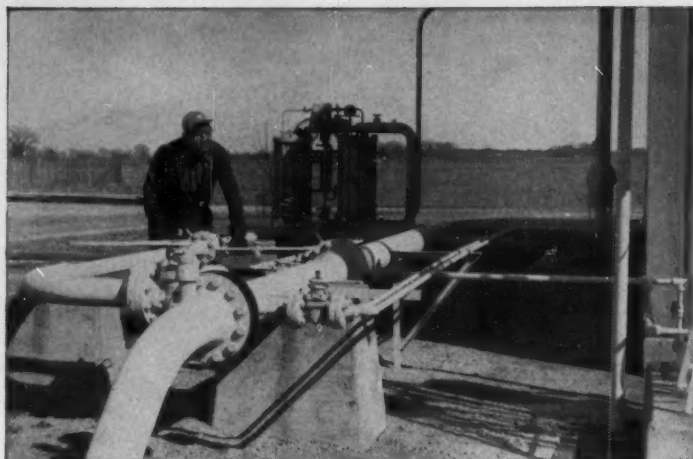
DRY natural gas to a -50° F. dewpoint before pressurizing for underground storage

185 million cubic feet of gas is stored underground in high pressure pipe sections by Northern Illinois Gas Company

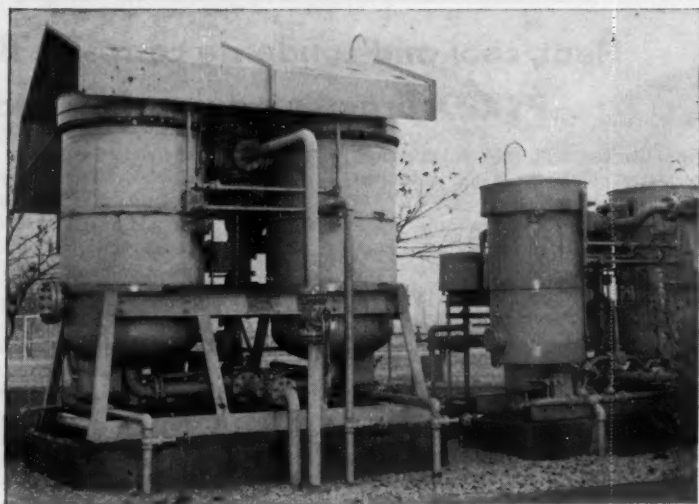
TEN underground storage fields, strategically located throughout its service area, are maintained by Northern Illinois Gas Company for possible emergency use.

Lectrodryers DRY and Lectrofilters* CLEAN the natural gas before it is compressed for storage. Thus, when the gas is withdrawn from the high pressure storage units, there's no moisture to cause valve freeze-ups. Gas feeds into the lines without interruption.

Whatever your DRYing problem—involving air, gases or organic liquids, at low or high pressures, in small or large volumes—there's a Lectrodryer able to handle it. Write for literature, telling us what you want to DRY. Pittsburgh Lectrodryer Company, 303 32nd Street, Pittsburgh 30, Pennsylvania (a McGraw Electric Company Division).



This BWC-150 Lectrodryer handles the DRYing at the 4,800,000 cu. ft. Rock Falls plant.*



A BWC-1500 and BWC-750 Lectrodryer serve the 120,000,000 cu. ft. Mt. Prospect field.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

**LECTRODRYERS DRY
WITH ACTIVATED ALUMINAS**

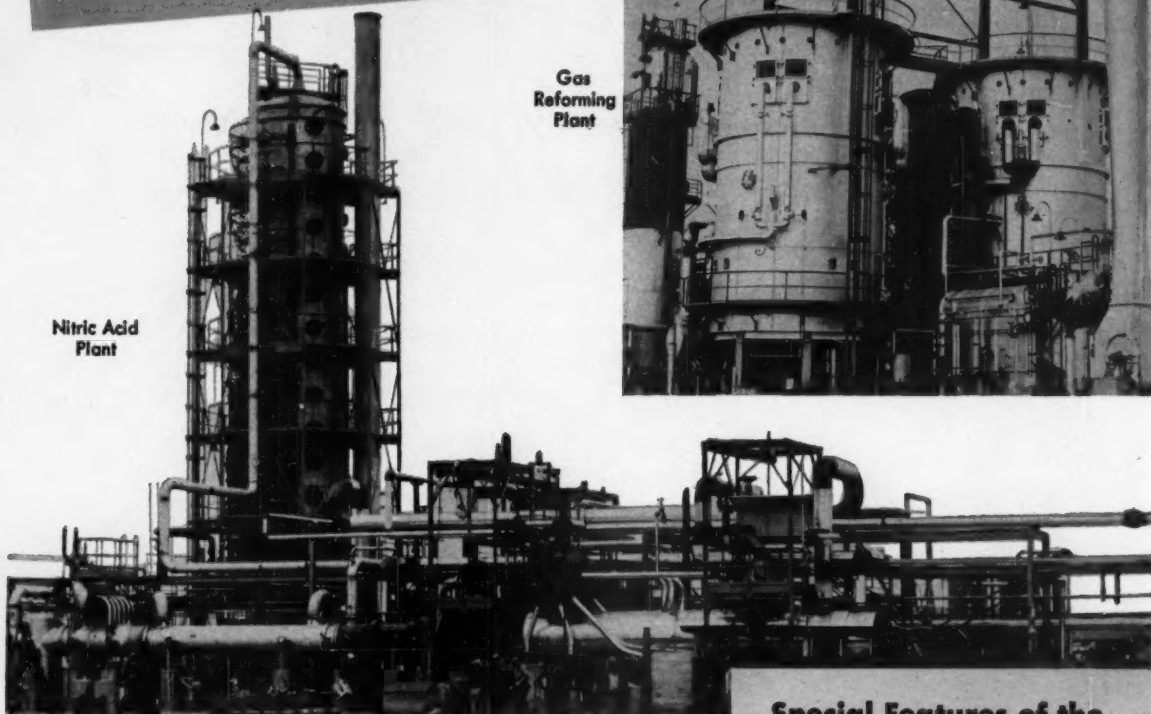
LECTRODRYER

* REGISTERED TRADEMARK U. S. PAT. OFF.

**One of the most modern
Fertilizer plants
in the world...
built in 8 months**

**Nitric Acid
Plant**

**Gas
Reforming
Plant**



now in operation at Pensacola, Florida

The new nitrogenous fertilizer plant of Escambia Bay Chemical Corporation, the Pensacola Plant, brings to forty-nine the number of major nitrogen plants designed and constructed by Chemico in the United States and abroad. Altogether, Chemico-designed plants produce approximately 25% of the world's supply of ammonia.

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

Designers and constructors of complete plants and facilities for the chemical and petrochemical processing industries for over 40 years

525 WEST 43rd STREET, NEW YORK 36, N. Y.

Technical Representatives: Cyanamid Products Ltd., London, South African Cyanamid (Pty.) Ltd., Johannesburg. Cable Address: CHEMICONST, N. Y.

Special Features of the New Pensacola Plant

Daily capacities:

- 200 tons of anhydrous ammonia
- 220 tons of nitric acid produced as 56% solution
- 275 tons of ammonium nitrate produced as 83.5% solution
- 350 tons of coated and pebbled ammonium nitrate

Improvements pioneered by

CHEMICO...

Substantial energy savings effected by the reforming of natural gas under pressure.

A carbonate absorption system for removal of carbon dioxide.

Power requirements reduced by use of gas turbines in the nitric acid unit combined with a catalytic combustor to eliminate air pollution.



The risk is too great —clean it right

You don't take risks when men, equipment, and lost production time are involved. That's why more and more companies are investigating the methods and firms used in their chemical cleaning. They know it's work for experts.

What are they concerned about?

First, they want to know they are getting the benefits of experience. These benefits include less downtime and more thorough cleaning.

Dowell has this experience with over 15 years and 10,000 boilers alone to their credit. In saving downtime, Dowell often cleans equipment while it is in operation.

Next, these companies want to be sure their men and equipment have the greatest possible protection. Dowell excels here, too. For safety is foremost in the Dowell engineer's mind. Thoroughly trained, he uses only the latest safety methods and

equipment. He works closely with your safety personnel to establish safest possible working procedures.

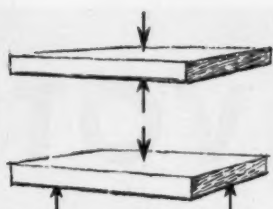
Be sure you are getting maximum results with maximum protection in your chemical cleaning.

Call the Dowell office near you. Dowell engineers are ready to discuss and help you with your cleaning problems any time, at no obligation. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Dept. D-33.

chemical cleaning service for industry

DOWELL

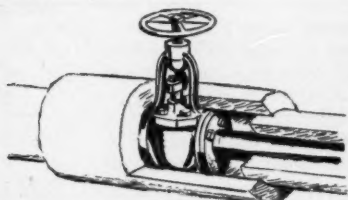
A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY



Unequaled compressive
and flexural strength!



Saw it... nail it...
shave it... drill it!



Bridge joints and fittings
without fear of breakage!

KAYLO® and FIBERGLAS*

INDUSTRIAL
INSULATIONS

... distributed by approved Fiberglas distributor-contractors... offer the most versatile family of plant insulations available. With new *pink* Kaylo-20 (increasing the upper range of Kaylo by 600° F.!), you can now order—from *one* reliable supplier—complete insulation coverage *from lowest sub-zero to 1800° F.*, serving such extra-high temperature applications as catalytic cracking units, refractory wall backing for furnaces and boilers, and fireproofing of piping, equipment, and vessel skirts. See *Sweet's Files, Chemical Engineering Catalog*, or *Refinery Catalog*. Or write Owens-Corning Fiberglas Corporation, Dept. 97-D, Toledo 1, Ohio.



*T.M. (Reg. U.S. Pat. Off.) Owens-Corning Fiberglas Corporation
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CHEMICAL ENGINEERING—April 1956

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Heat Insulation

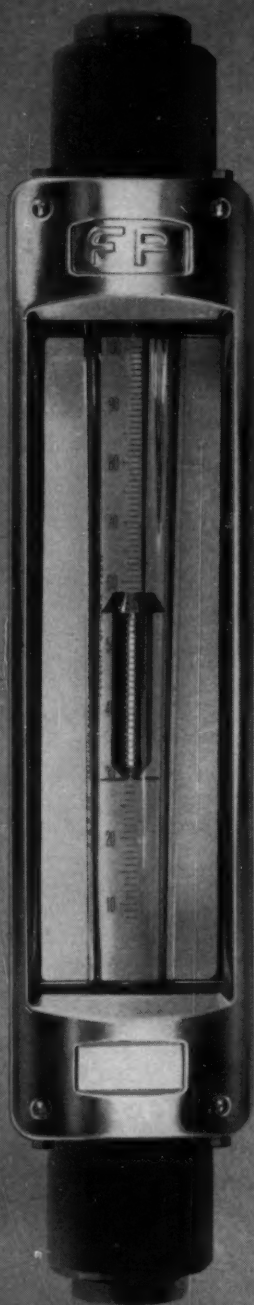


*for strength
and lightness!*

BEFORE YOU VOTE

check this candidate for accurate flow measurement

Standardizing on one line of flowmeters has many benefits. But before you vote for a specific line of meters check *all* the advantages of F&P 1700 Series Flowrator meters. More and more companies are voting F&P meters their standard. Here are a few reasons why:



Write for Catalog 10-A-25 completely describing the 1700 Series Flowrator meters.

LA3979



The Rugged Enclosure of the 1700 Series flowmeter provides wide-angle 130° visibility, increased strength, attractive appearance and freedom from tube stress.



One Basic Design permits three types of enclosures, 360° "rotability" of connections, interchangeability of parts and packing, and ease of maintenance.



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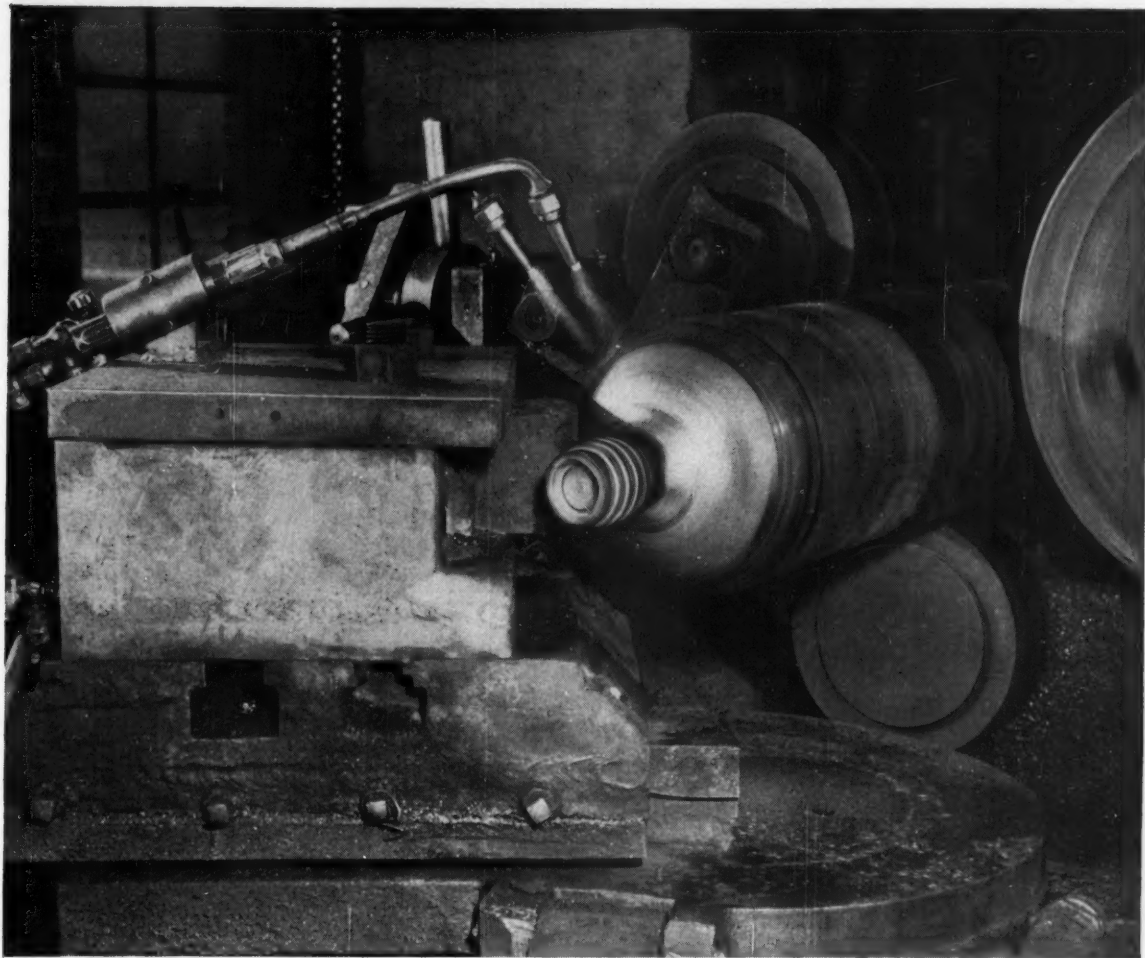


The Dependable Performance of F&P Flowrator meters has made them the accepted standard throughout industry for 19 years.

Compare, consider, try—and then pick your choice for standardization. We're sure you'll vote a straight F&P ticket.

FISCHER & PORTER CO.

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How to bottle up 2400 psi

The Marison Company of South Elgin, Ill., is a leading producer of industrial oxygen cylinders manufactured to hold this active gas at 2400 psi. From its beginning, Marison has consistently used Seamless Tubing for this task.

Marison has found B&W Seamless Tubing to be ideal for its complicated cycle of spinning, forming, heat-treating and threading operations. Every ounce and every inch of tubing—and every operation by Marison—must be flawless in every respect to meet the demands of these pressure cylinders.

Whatever your requirements in tubing...for consistently high and uniform quality...for top service...look to B&W. For more information on selection

and use of carbon, alloy or stainless steel tubing, write for Bulletin 361 or call in Mr. Tubes, your nearby B&W Tube Representative. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.



TA-5075P

Seamless and welded tubular products, seamless welding fittings and flanges—in carbon, alloy and stainless steels

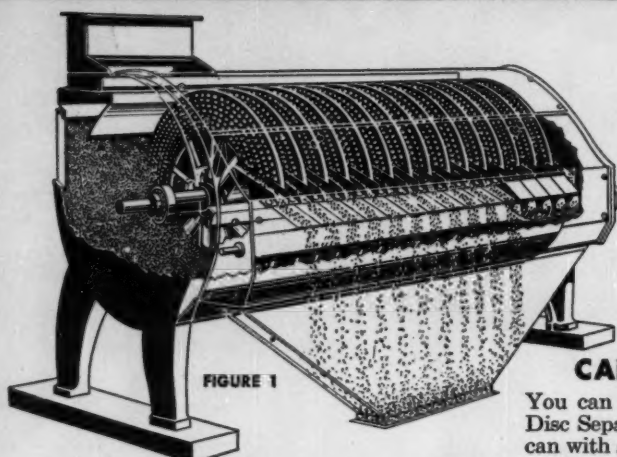


FIGURE 1

FOR ACCURATE LENGTH SIZING OF FREE-FLOWING GRANULAR MATERIALS

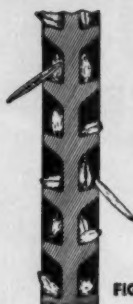


FIGURE 2

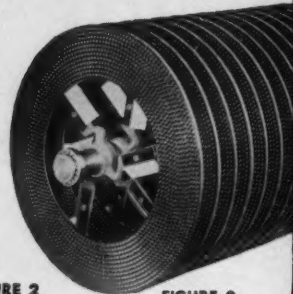


FIGURE 3

CARTER DISC SEPARATORS

You can size free-flowing materials with Carter Disc Separators much more accurately than you can with screens. That's because Carter discs size by *length* differences. In each disc there are hundreds of under-cut pockets which lift short material and reject long material that does not fit into the pockets. Fig. 1 shows how material flows through the Disc Separator. Fig. 2 shows how the discs lift or reject. A series of discs is shown in Fig. 3. Sizes of Carter Disc Separators differ in the number of discs and in the diameter of the discs, and there is a wide range of pocket sizes and styles.

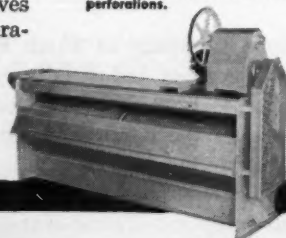
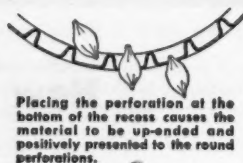
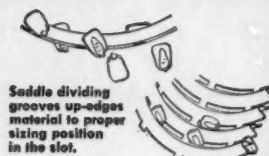
HART UNI-FLOW CYLINDER SEPARATORS



While Disc Separators perform precise separations, Uni-Flow Cylinder Separators are recommended when you need less accuracy or more flexibility. In the Uni-Flow Separator the material is lifted by semi-spherical indents (A) that line the inside surface of the cylinder. The operator controls the separation by raising or lowering the separating edge (C) of the trough (B) into which the lifted material falls.

CARTER PRECISION GRADERS For Sizing by Thickness or Width

Because of the unique design of the perforated cylinders used in Carter Precision Graders, these machines make separations to a degree of accuracy hitherto unobtainable. Thickness separations are made by slots at the bottom of grooves in the cylinder. Width separations are made by recessed round perforations in the cylinder.



FREE TESTING You are invited to send—or bring—samples of your materials to the Hart-Carter laboratory for free testing. (Ask us about the size sample required.) Results will be kept confidential. Knowing your requirements, Hart-Carter will recommend the machines you need. Hart-Carter machines are being used to size such materials as polyethylene and nylon cubes, and catalyst pellets. **WRITE FOR FOLDERS** that describe in detail the sizing methods used by each kind of machine.



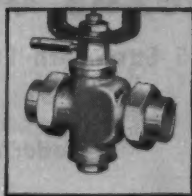
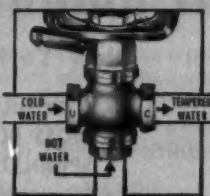
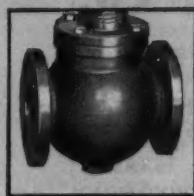
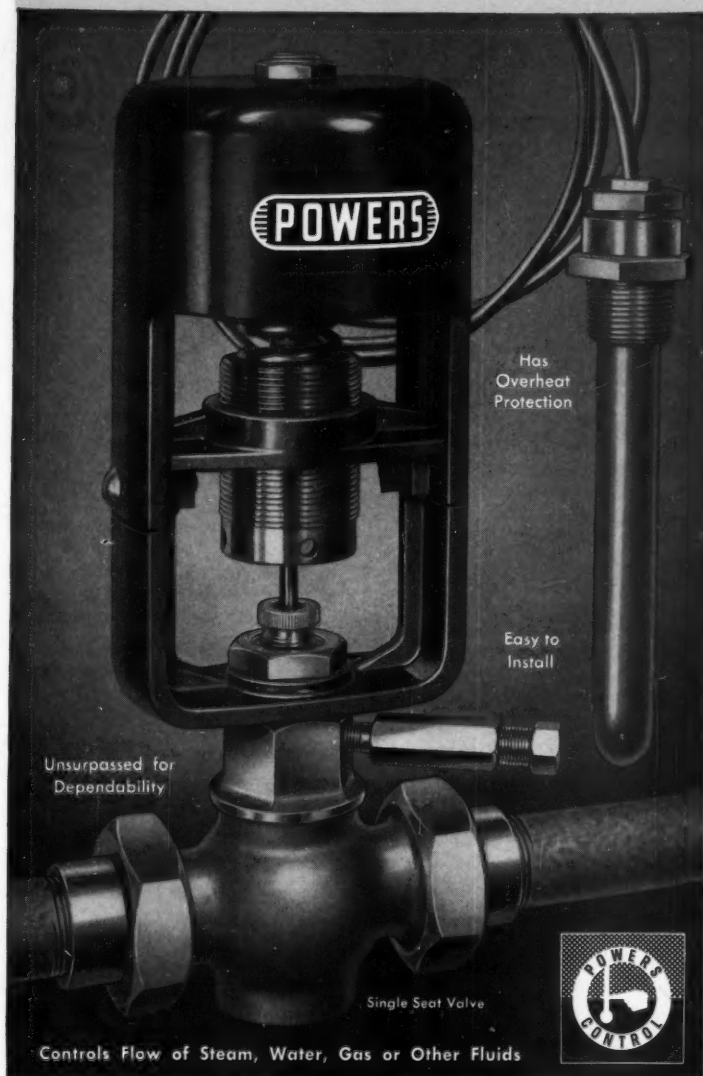
HART-CARTER CO.

661 19th Avenue N.E., Minneapolis 18, Minn.
Phone: Sterling 9-2417

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GRANULAR MATERIALS BY DIMENSIONAL
DIFFERENCES**

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Automatically holds temperature constant at the right point.
Prevents losses caused by wasteful OVER-heating.

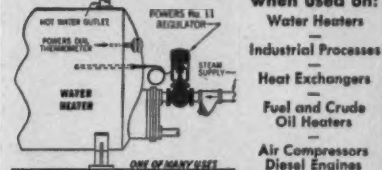


Various Valve Bodies and Inner Valves are available. Single and Double Seat Valves thru 2" have rugged bronze bodies with bronze union connections for quick, easy installation. Bulletin 329 gives information about all types.

(c38)

Why It Gives BETTER CONTROL and Saves More Money

Often repays its cost 3 to 6 times a year when used on:



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- **Valve stem lubricator** with silicone grease aids easy movement of highly polished stainless steel valve stem and reduces drying out of packing.
- **BETTER CONTROL** results from Powers powerful bellows and minimum of valve stem friction.
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- **Rugged bronze valve bodies with bronze union connections**, for single and double seat valves thru 2", reduce installation time and labor. Larger sizes have flanged iron body valves.
- **Powers Nationwide Service and 24 Hour Delivery** in the U.S.A. are important time and money saving advantages.



● **Indicating Regulator** with easy to read 4" dial thermometer helps adjust the regulator and check temperature at the bulb. Various dials and ranges are available.

Right type and size of valve is important for good control. May we help you make the right selection? Benefit from

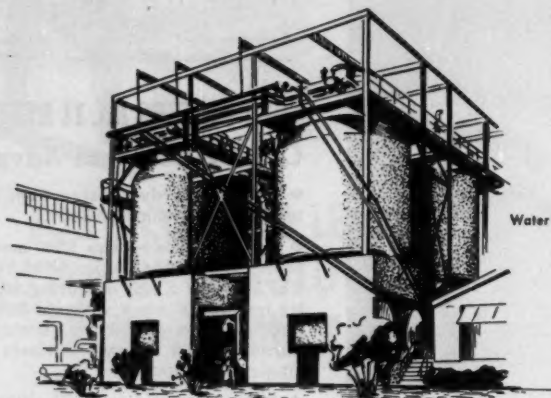
POWERS more than 60 years experience with self-operating regulators.

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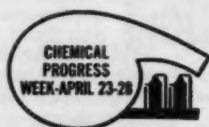
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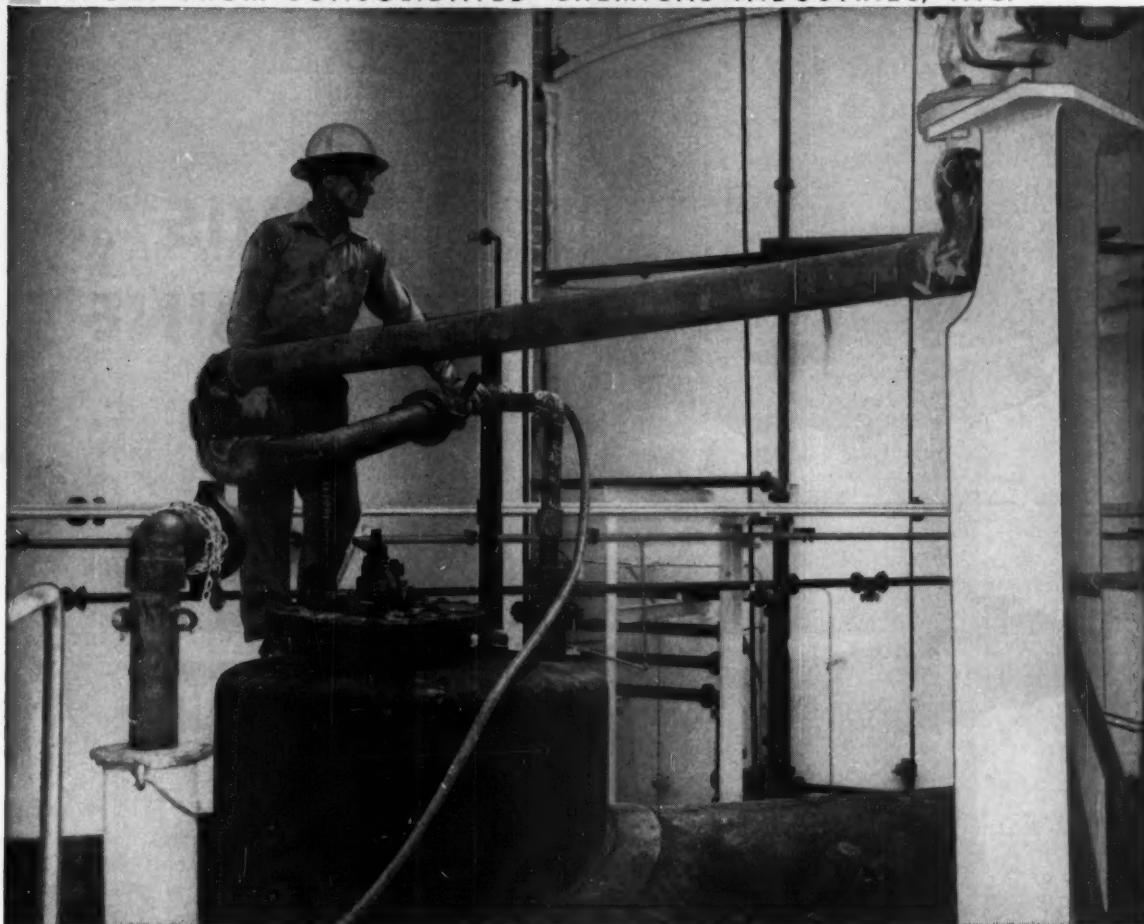
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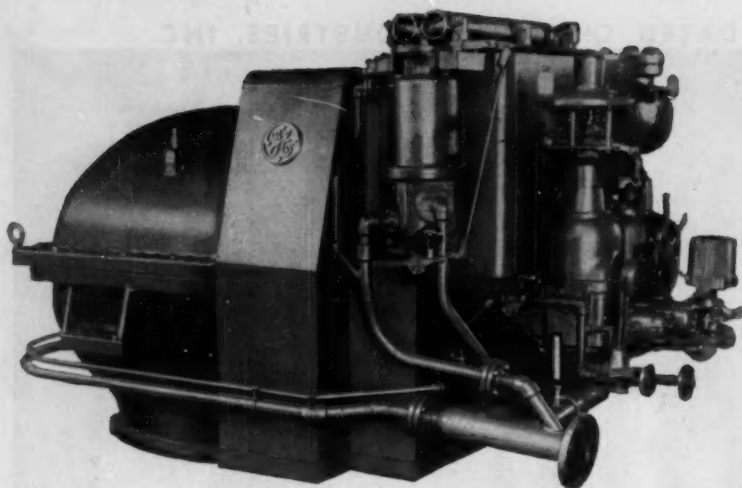


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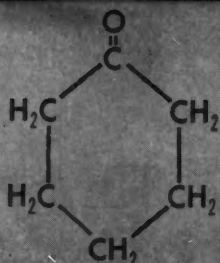


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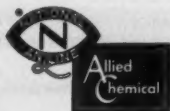
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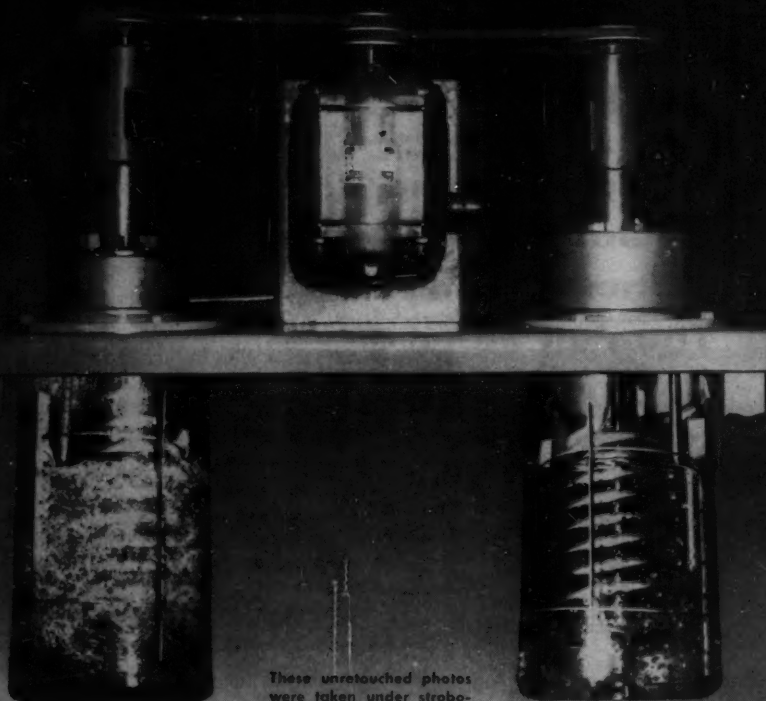
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TOMORROW'S BIG DECISIONS WILL BE MADE **by the men who act today...**

NEW AUTOCLAVE "DISPERSIMAX" . . .

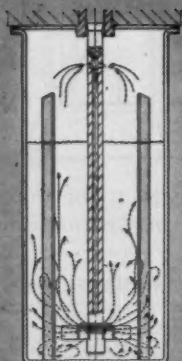
The Answer to Maximum Gas Dispersion



"Dispersimax" Agitation

These untouched photos were taken under stroboscopic light. Both shafts rotating at 600 r. p. m.

Ordinary Agitation



The path of the dotted arrows indicates Flow Pattern.

Autoclave Engineers have been instrumental in the development of the "Dispersimax." The impeller of this device pumps gases continually through a liquid kept in constant agitation in the presence of a suspended catalyst. This greatly increases the interfacial contact of solids, liquids and gases. Extensive tests at the University of Pennsylvania have shown that this device will decrease reaction time many fold and in a great many cases is expected to result in reactions taking place at lower pressures, which would mean lower costs for plant size equipment. The drawing at the left shows how the "Dispersimax" works. The hollow rotating shaft is provided with inlet ports above the liquid level and outlet ports at the impeller. Rotating impeller blades at the bottom of the shaft create a suction which circulates the gas continuously down through the shaft and out through the liquid with its suspended catalyst.

Here is another example of Autoclave Engineers constant search to produce better tools for research. Write for Bulletin No. 1254.

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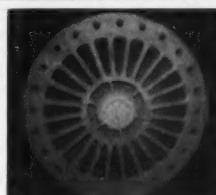
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P9506, Chemical Engineering
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CHICAGO: 530 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)
LOS ANGELES: 1125 W. 6th St. (17)

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Assistant Chief Engineer, age limit 45. Must be graduate mechanical, chemical or civil engineer with natural mechanical ability, excellent practical and supervisory and some construction experience, for charge under Chief Engineer of all shops, foundry, mobile equipment including loading, marine, railway and construction; maintenance and repair of all types of equipment; 7200 KVA diesel generating plant. Mine and mill 2600 tons/day. Flotation Mill Copper. Salary open. Foreign. With initial letter send full experience, references, age, marital status, number and age of children. Reply: Cyprus Mines Corporation, Suite 1206, 523 West Sixth Street, Los Angeles 14, California.

Wanted Chemical Engineer with experience in contact Sulphuric Acid manufacturing for Michigan area, under 30 yrs of age; send photo, resume of experience and salary expected. P-9333, Chemical Engineering.

Wanted—Small manufacturer of waterproofing materials and masonry treatments desires to contact chemical engineer who will act in advisory or research capacity on a "side line" basis. Must know Portland Cement technology and be located near New York City. Answer with complete education and practical experience data. P-9447, Chemical Engineering.

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Write to Technical Personnel Department

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A top opportunity.

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1

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2

HEAT TRANSFER

Duties include: trouble-shooting on equipment, such as pipe line reactors, fluidized solids reactors, and film driers, where heat transfer is one controlling factor; selection of equipment, such as heat exchangers, evaporators, furnaces, and driers; evaluation of equipment to determine optimum alternatives; and theoretical analysis of problems in heat transfer in proposed equipment for new applications. Other typical heat transfer problems encountered involve reboilers, inert gas generators, direct fired production furnaces, and indirect fired retorts.

3

PROCESS ANALYSIS AND EVALUATION

Duties are: Assistance in the preparation and analysis of basic information for design of operating units and supporting facilities in order to obtain optimum performance with minimum investment and operating costs; preparation of flow sheets; evaluation of process alternatives; selection and approximate sizing of equipment; and establishment of heat and material balances. Position requires five or more years of experience in equipment selection, economic evaluation of processes, and development of information for design of industrial facilities.

4

APPLIED REACTION KINETICS

Successful applicant will: assist research and development groups in planning experimental work to study reactions in the development of new processes, and products; recommend types of laboratory equipment, conditions for the experiments, and data to be obtained; interpret laboratory and semi-works data; and use these data to specify size and type of plant equipment and operating conditions. Will also investigate possibilities of increasing capacities and yields through modification of existing plant equipment or operating conditions.

5

FLUID FLOW

This position will require extensive experience with very complex fluid flow problems, such as are encountered in the following types of equipment: distillation, dust collecting, filtration, grinding, drying, materials handling, absorption-extraction, and agitation and mixing. Successful applicant will develop specialized equipment such as jet reactors, jet compressors, jet absorbers, and pipe line reactors, and provide technical advice on fluid flow problems involved in handling slurries, plastics, highly viscous polymers, dispersion, and semi-solids.

6

FILTRATION

Position requires broad and extensive knowledge of applications of techniques for separating liquids and solids, such as filtration, centrifuging, sedimentation, wet-screening, liquid cyclones, etc. Duties include: trouble-shooting on existing equipment; increasing capacity and improving performance; evaluation of alternative equipment; specification of filtration installations; and selection of auxiliary equipment such as vacuum pumps, agitation equipment, and mist separators. A major responsibility is to keep informed on latest technological advances in the field.

INTERVIEWS IN NEW ORLEANS May 6-7-8-9 (Sun-Mon-Tues-Wed)

For appointment, please call

Mr. J. C. Costello, Jr.

MAgnolia 2371

Or you may send complete résumé, including details of education and experience, to:

Mr. J. C. Costello, Jr.

Engineering Department



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PATENTS

Petroleum company has the following positions available in Cleveland, Ohio, in a small but expanding patent division of a research- and patent-minded organization:

1. Patent attorney with sufficient experience in chemical applications to work with minimum supervision in preparing and prosecuting applications before the Patent Office and proceedings in which they may become involved.
2. Chemist or chemical engineer with at least BS, recent graduate, as trainee in patent division. Night law school available with generous company contributions towards law school courses.
3. Chemist with some research background for work with research division in liaison with patent attorneys. Some experience in this area essential, and preferably in the petroleum industry.

THE STANDARD OIL CO., (Ohio)

Reply to E. G. Glass, Jr., 1737 Midland Bldg.,
Cleveland 15, Ohio

DESIGN ENGINEERS

You can fill a desirable permanent position in McKee's enlarged Refinery, Metals or Industrial Divisions. Our expansion program gives you excellent opportunity for advancement in one of the world's largest engineering firms.

World-wide McKee operation offers you wide choice in the design of Petroleum Refineries, Chemical Plants, Blast Furnaces, Steel Plants, Sintering Plants and Industrial Plants in the following fields:

PIPING LAYOUT, STRUCTURAL STEEL, CONCRETE, PROCESS HEATERS, EQUIPMENT SPECIFICATIONS, LAYOUT AND PROCESS DESIGN. ALSO PIPING AND ELECTRICAL DRAFTSMEN.

You get top compensation, the security of a life-long pension, paid vacations, benefits of insurance, hospitalization, sick-leave pay and training program.

You'll work with modern equipment in large air-conditioned quarters. Free parking on premises.

Cleveland has attractive residential areas, excellent schools and colleges for you and your family. McKee makes generous transportation and moving allowances.

Write for an interview giving education and experience. No age limitations. All letters kept strictly confidential. Write today to:

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**ARTHUR G. MCKEE
& COMPANY**
2300 Chester Avenue
Cleveland 1, Ohio

PROCESS ENGINEER

Excellent career opportunity for young versatile ChE with rapidly expanding independent oil company.

Experience: 2-5 years process experience in manufacture of liquid organic chemicals; preference will be given for styrene experience.

Primary assignment: process duties on new multi-million dollar chemical plant scheduled for December completion.

Please address complete resume, academic record, salary requirements to:

Manager of Manufacturing

COSDEN PETROLEUM CORPORATION
Big Spring, Texas

EXCEPTIONAL OPPORTUNITY FOR PROCESS DESIGN ENGINEERS

Large eastern chemical industrial concern has openings at Niagara Falls, New York for process design engineers with B.S. or M.S. degree in chemical, electrical, or mechanical engineering. Responsibilities will involve sufficient knowledge to translate pilot plant and process development information into full scale plant design. Electrical engineers with rectifier experience helpful. Prefer five years industrial experience. Excellent facilities, salary and opportunity above average.

Your reply will be held confidential. Include age, education, experience, and salary requirement. Our employees know of this ad.

P-9368, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

CHEMICAL ENGINEERS

Chemical plant, located in South Charleston, West Virginia, producing chlorine, caustic soda, carbon disulphide and related organic and inorganic compounds, has challenging openings for:

PROCESS DEVELOPMENT ENGINEERS with up to eight years experience in development, research or operating work to carry out studies to improve existing operations, design and assist in the start-up of new operations.

OPERATING SUPERVISORS for responsible rotating shift supervision in production areas. Chemical engineers or chemists with one to four years experience preferred.

MAINTENANCE ENGINEERS with up to 15 years supervisory or staff experience in chemical plant maintenance work.

PROJECT ENGINEERS with up to ten years experience in technical supervision of construction projects and process design necessary for the preparation of engineering drawings and in the direction of field installations.

All applicants replying should have potential for promotion. Please send resume and salary requirements to:

WESTVACO CHLOR-ALKALI DIVISION
FOOD MACHINERY and CHEMICAL CORP.

Drawer 5127
South Charleston, West Virginia
Attention: Department 5

EXCEPTIONAL ENGINEERING OPPORTUNITY

The Liquid Carbonic Corporation has a position available for a project engineer who desires achievement and advancement with an expanding and aggressive leader in the chemical field. This job can definitely lead to responsibilities in management.

The position requires a graduate chemical engineer with five to ten years' experience in process engineering, equipment specifications, instrumentation, etc. The man must be capable of handling a broad range of assignments.

Please submit complete resume, including details of education and experience, salary requirements, and, if possible, a recent photograph. All replies will be treated with strict confidence and you will receive an immediate reply.

PERSONNEL DEPARTMENT

THE LIQUID CARBONIC CORPORATION
3100 SOUTH KEDZIE AVENUE
CHICAGO 23, ILLINOIS

CHEMICAL ENGINEERS

Expanded activities require additional engineers in our plants and on our central staff. For the engineer who is inclined toward development and process investigation work leading to key man production responsibilities, this is an excellent opportunity to be in the right place at the right time. We currently have openings in our Demopolis, Alabama and Bainbridge, N. Y. plants as well as on our central staff located at Bainbridge. Write stating education, experience, qualifications, salary expected giving complete details in first letter. All communications will be answered and will be held in strict confidence. Address:

THE BORDEN COMPANY
Chemical Division
BAINBRIDGE, N. Y.
Attention: D. R. Long

CHEMICAL ENGINEER

For control laboratory and supervising general plant operations on evening shift at each of two branch plants of national manufacturer. Plants located in Camden, N. J. and Charlotte, N. C. Specify choice of location. Age preference 24 to 35. Give age, education, experience and salary expected. Recent snapshot if available. Replies confidential.

P-1050, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

Procter & Gamble needs CHEMICAL ENGINEERS

(Graduated within last 10 Years)

- Permanent positions in Chemical Process Equipment Design and Application and other Engineering Fields.
- Salaries commensurate with education and industrial experience.
- Opportunities to grow with a leading chemical processing company—rated as one of the nation's three best-managed companies by the American Institute of Management.

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Mr. J. E. Gale
Head of Employment
Engineering Division
The Procter & Gamble Company
Cincinnati 17, Ohio

Development and Application Engineers

Major multi-plant chemical company needs several young chemical engineers, age to 35, who are interested in working in broadly diversified areas of engineering development and application. Principal duties include aiding plant operating, technical, and research personnel in problems requiring technical foresight and know-how for solution. Salaries attractive. Rate of advancement dependent only on engineer's own performance, demonstrated ability, and productive ambition.

Please submit detailed résumé,
IN COMPLETE CONFIDENCE to:

P-1114, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

Physical Chemists or Inorganic Chemists

for investigation of gas-solid reactions, chemical thermodynamics, reaction kinetics, surface chemistry and solid state physics. Chemistry majors at Phd, MSc and BSc will be considered for these positions.

Chemical Engineers for advanced process development work in Pilot Plant and Production Plant scale testing. Positions are in our process development program aimed at

more efficient and more economical production of nuclear fuels for the various types of nuclear reactors now in operation and under consideration.

Positions also available for
Analytical Chemists,
Ceramic Engineers,
Statisticians,
Metallurgists, and
Metallurgical Engineers.

For prompt and complete information, address resume of education and experience to Employment Supervisor.



WANTED TECHNICAL EDITORS

To provide for its continued growth Chemical Week is seeking two additional assistant editors — preferably chemists or chemical engineers with two to three years business experience. Essential: Ability to meet people, dig out facts, interpret them intelligently and write lucidly. Please submit resume to:

PERSONNEL DIRECTOR
McGRAW-HILL PUBLISHING CO.
330 W. 42ND ST.
NEW YORK 36, N. Y.

HEAT TRANSFER ENGINEERS SELLING OPPORTUNITIES

We require several chemical engineers for our branch offices with two or more years experience in heat exchanger design. Long established firm offers challenging opportunity to sell widely used heat transfer product whose sale involves technical ingenuity and initiative. Salaried position with incentive advantages. Must be free to relocate. Reply in confidence giving complete resume and expected salary.

P-8972, Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

PROJECT ENGINEER

National Engineering and Construction Company seeks an experienced Project Engineer with several years of petroleum engineering background for work in the Midwest.

This man must be capable of taking complete charge of a job, supervise layouts and design, select plant equipment, and maintain amiable customer relations.

In applying furnish a detailed resume of your education, experience, references and a recent snapshot if available. Salary open.

P-9421 Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

(Additional Employment Advertising Continued on following page)

EMPLOYMENT OPPORTUNITIES

(Continued from preceding page)

WANTED

CHEMICAL ENGINEERS

For process development and production work. Two to five years' experience preferred. Modern expanding chemical manufacturing plant in New Martinsville, West Virginia. Long-range multi-million-dollar expansion program now in progress. Modern research and development facilities just completed. Excellent opportunities.

Write

**COLUMBIA-SOUTHERN
CHEMICAL CORPORATION**
New Martinsville, W. Va.

Attention: Industrial Relations Dept.

CHEMICAL ENGINEERS

Our expanding CHEMICAL DIVISIONS are major producers of a diversified line of industrial and agricultural chemicals. We have plants in

New York	Arkansas
New Jersey	Kansas
Maryland	Wyoming
West Virginia	Idaho
California	

Openings with unusual opportunities for growth are available for qualified men with and without experience in:

**Process Development
Production Supervision
Design and Construction
Pilot Plant Operation
Technical Service**

Please send complete resume of your training, experience and employment interests to:

**Technical Personnel Manager
Chemical Divisions**

FOOD MACHINERY and CHEMICAL CORP.
161 East 42nd St., N. Y. 17, N. Y.

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(Classified Advertising)

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**CITIES SERVICE OIL
PARTRIDGE,
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WANTED

ELECTROCHEMICAL PROCESS

We have available 1500 KW Direct Current Generating Equipment suitable for Electrolytic Process Work.

CW-9473, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

WANTED

CONTACT SULFURIC ACID PLANT

25-100 Ton Capacity

W-9578, Chemical Engineering
68 Post St., San Francisco 4, Calif.

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Chemicals—Dyes—Drugs
Colors—Pigments—Oils—Waxes
By-Products—Wastes—Equipment

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80-04 Beaver St. New York 5, NY

WE NEED

All Kinds of Oil Refinery and Chemical Equipment, also Tanks

Write—Wire—Phone
Weinstein Co., Div. of Surplus & Salvage Co., Inc.
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WANTED TO BUY

ONE 8 x 10 USED PEBBLE MILL
SUITABLE FOR WET GRINDING

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W-9411, Chemical Engineering
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for
Equipment Opportunities

AVAILABLE

CUSTOM REFINING FACILITIES . . .

- Complete Distillation Service • Distillations
- Extractions • Fractionations
- Drum Lots—Tank Cars
- All Types of Crude Mixtures
- By-Products, Residues, Wastes
- Contaminated Solvents

WANTED

Truland CHEMICAL &
ENGINEERING CO., Inc.
Box 426, Union, N. J. MUrdock 6-5252

FOLLOW THE ROUTE TO REAL SATISFACTION BUY BRILL



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- 1—Vulcan 8'x125' Rotary Kila.
- 2—Vulcan 6'x40', 5½'x50'.
- 3—Link Belt 3'10"x12", 5'2"x20', 7'5"x20' S/S.
- 4—Devine #27 double door Vacuum Shelf 17—59"x78" shelves.
- 1—Devine Vacuum six 40"x43" shelves.
- 1—Struthers-Wells 5'x15' nickel Rotary Vacuum.
- 1—Devine 5'x10' Steel Rotating Vac.
- 2—Stokes 30"x8', 3'x15' Rotary Vac.
- 1—Louisville 38x25' Rotary Steam Tube.
- 4—Bufllovak Double Drum 42"x120", 42"x90", 36"x84", 32"x90".
- 1—Hersey 18"x12' Rotary Hot Air 304 S/S complete with all accessories.
- 2—Bufllovak 6' and 3' dia. Crystallizers.

FILTERS

- 2—Oliver Rotary, Monel 8'x10', 3'x2'.
- 1—Feinc 5'x7' S/S Rotary Vac.
- 1—Feinc 5'x3' Monel, Rotary Vac. String.
- 1—Feinc 3'x1', 316 S/S Rotary Vac. String.
- 1—Oliver 5'3"x3' rubber lined Rotary Vac. Precoat.
- 2—Sweetland #12, 72 and 36 leaves.
- 4—Sweetland #3, #5, #7, #10.
- 2—Sweetland #3, S/S shell and leaves.
- 1—Niagara 53 sq. ft., 304 S/S.
- 1—Shriver 42" P&F 40 chambers.
- 3—Shriver 36" P&F 42 chambers.
- 2—Shriver 30" P&F 30 chambers.
- 6—Sperry 24" P&F 16 chambers.
- 2—Sperry Aluminum 30"x24".

PULVERIZERS—CRUSHERS

- 2—Ball & Jewell #1½, #2 Rotary Cutters.
- 1—Devine 5'x10' steel jacketed Mill.
- 4—Hardinge Mills 4½'x16", 6"x22", 7"x36".
- 1—Raymond #40 Imp. Mill, 304 S/S.
- 4—Patterson 6'x8', 5'x6', 3'x4' brick lined Pebble Mills.
- 1—NEW Patterson 6'x8' porcelain Pebble Mill 50 HP.
- 1—National 6"x12" Plastic two-roll Mill.
- 3—Gayco Air Separators 6', 3', 18" dia.
- 3—Mikro Pulverizers #4TH, #2.
- 1—Fitzpatrick Mod D Comminuter S/S.

CENTRIFUGALS

- 2—AT&M 42" Suspended, 347 S/S.
- 1—AT&M 40" Suspended, rubber perforated.
- 1—AT&M 40" Suspended, steel.
- 1—Bird 40" Suspended, rubber.
- 3—Tolhurst 40", 32", 28" Suspended, steel.
- 1—AT&M 36" center-slung, rubber.
- 1—Fletcher 30" center-slung S/S.
- 1—Fletcher 30" Suspended, steel.
- 1—Tolhurst 28" Suspended, rubber.
- 2—Bird 32"x50", 36"x50" Steel, solid bowl Continuous.
- 2—Bird 18"x28" solid bowl, 310 S/S.
- 1—Sharples PN-14 Super-D-Canter, L.
- 1—Sharples PN-14 Super-D-Canter, Monel.
- 2—Sharples #C-27, #C-20, S/S Super-D-Hydrators.
- 2—Sharples #16-P Monel and S/S Super Centrifuges.

MIXERS

- 10—Day "Cincinnatus" double arm Sigma Blade, 660, 250, 100 and 50 gals.
- 2—Baker Perkins 100, 50 gal. Sigma Blades, jacketed.
- 1—Patterson-Kelly 75 cu. ft. Twin Shell, S/S.
- 2—Robinson 90 cu. ft. 316 S/S jacketed powder.
- 3—Steel jacketed Powder 50, 225, 265, 350 cu. ft.
- 1—Struthers-Wells 6'x9' S/S jacketed.
- 2—Patterson 6' and 5' Steel Conical.
- 2—Baker Perkins 2 gal. S/S.
- 1—Robinson 4000# steel Powder.
- 6—Rodgers 400 to 3000# Powder.
- 1—Simpson Intensive Mixer #0.
- 8—NEW Portable Agitators ¼ to 5 HP.
- 4—Day, Ross 8 and 50 gal., Pony.

TOWERS—REACTORS—CONDENSERS & TANKS

- 2—8'x12' Vertical Tanks 347 S/S 5,000 gal. ½" shell.
- 2—Horizontal Steel Tanks 10'x40', 10'x30', ½" shell.
- 8—Towers 7'x25'6", 347 S/S, 6'x63', 6'x34', 5'x96', 30'x70', 24'x42', 12'x30', 8'x20'.
- 4—Bufllovak 4000 gal. steel, jacketed, agitated Reactors 50 psi.
- 1—10,000 gal. Aluminum Storage Tank 10'x16'x½" shell.
- 4—Foster Wheeler Karbate Heat Exchangers 189 sq. ft.
- 3—Heat Exchangers 100, 200 and 300 sq. ft., 304 S/S.
- 12—Heat Exchangers 50 to 2400 sq. ft. Admiralty and steel.

MISCELLANEOUS

- 1—Foster Wheeler Dowtherm Unit with super heater, 4½ million BTU.
- 8—Nash Vacuum Pumps, #H-7, #H-6, #4, #2, #L5, #L3, #MD571.
- 2—Beach-Russ #50D Vacuum Pumps, 50 cfm.
- 20—Durimet, Olivite 316 S/S Durrion Centrifugal Pumps 1" to 3".
- 10—Centrifugal Pumps 60 to 2000 gpm. motor driven.
- 14—Stokes DDS2, D4, "R", and "T" Tablet Machines.

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- 1—I.R. Jet Refrigeration Unit complete 136 Tons 50° F to 45° F.
- 1—Patterson 7'6" Conical Blender rubber lined.
- 1—Bufllovak 6'x5'6" Monel Drum Flaker NEW.
- 1—Pfaudler 250 gal. Hastelloy "C" Reactor.
- 3—4'x13' closed 316 S/S Reactors, 109—3'6", 316 S/S tubes, 150 psi.
- 1—2500 gal. 316 S/S jacketed Reactor.
- 1—Pfaudler 5'x18' Horiz. glass lined 2500 gal.
- 1—7500 gal. 316 S/S clad 12'x6'x5'6" cone.
- 3—Link Belt 316 S/S 18"x12", 18"x10', 18"x7' twin screw Conveyors.
- 2—Detroit 5 ton Air Hoists.

SCREENS

- 4—Rotex double and single deck 40"x120".
- 2—Rotex double and single deck 40"x84".
- 1—Patterson single deck 40"x84", S/S.
- 3—Robinson single deck 40"x84", S/S.
- 3—S. W. single deck 40"x84", S/S.

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Late Type Rebuilt Equipment UNION

For Immediate Delivery—Great Savings



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850 gal. Jacketed Mixing Tanks.
Day 35 to 75 gal. S. J. Imperial Double Arm Mixers.
Day 650 gal. Jumbo S. J. Mixer.
Stokes, Day, New Era, Hottman Mixers, from 2 to 450 gal., with and without Jackets, Single, Double Arm Agitators.
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Gemco 56 cu. ft. Double Cone Blender.
J. H. Day 50 gal. Imperial S. S. Jacketed Double Arm Mixer.
Day, Robinson, Bailey, 15 to 10,000 lbs., Dry Powder Mixers.

LABELERS

Models D and NA4 Knapp Wraparound Labelers.

Resina LC and Elgin Coppers.
Burt Wraparound Labeler, to gal.
Pony M, MX, ML, World, Ermold, Pneumatic Semi and Automatic Labelers.
Capem 4-Head Automatic Labeler.

FILLERS

Horix and Elgin Rotary Fillers.
S. & S. G1, G2, G6, HG88 Fillers.
MRM S. A. Stainless Steel Vacuum Fillers.
Triangle Elec-Tri-Pak Fillers, all sizes.
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Standard Knapp 429 Carton Sealers.
Pneumatic Scale Packaging Units with high speed Carton Feeders and Bottom Sealers, Weighers, Top Sealers with Compression Drying Units, Carton Liners, interconnecting conveyors.

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Mikro 3TH Pulverizers with 30 HP motors.
Mikro 2TH, 15H and Bantam Pulverizers: Schutz-O'Neill Mills.
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Podbelniak 6080 S. S. Solvent Extractor.
Oliver, Sweetland #2, Sparkler, Sperry, Shriver, Alsop Filters.

OVER 5,000 MACHINES IN STOCK—INSPECTION INVITED

Complete Details and Quotations Available—Write Today!

UNION STANDARD EQUIPMENT CO.

318-322 Lafayette Street New York 12, N. Y.

TOP PRICES PAID
FOR YOUR
SURPLUS EQUIPMENT

NEW AND GOOD-AS-NEW EQUIPMENT

1—Stainless Tank #430 Chrome, vert. 7'x10' deep.
10—Jacketed Kettles—Stainless, Copper, Aluminum.
1—Day Mixer, steam jacketed, 50 gal. Sigma Blade.
1—Copper Evaporator, steam jacketed, 9'x3'x9".
60—New Pressure Cookers, 18"x18" & 24"x28".
150—Pumps—steam and electric.
1—New Glass Nash Centrifugal Pump, 160 gpm.
1—New Nash Vacuum Pump Type AL-572.
1—Bufflovak Jacketed Impregnating Tank 42"x52".
1—4x8 Sturtevant Jaw Crusher.
1—Abbe Ball Mill, 36"x42" Buhrstone lined.
#316 Stainless Steel Tanks, new 100, 200 & 360 gal.
1—Nash Air Compressor, Type AL-623.
1—Manton Gaulin Stainless Homogenizer 125 gph.
1—I&R Vacuum Pump, 5 H.P., 60".
4—Heat Exchangers, 12" dia. 11' lg., 43 steel tubes.
1—Stokes Single Punch Tablet Machine.
1—Raymond #2 Hammer Mill, like new.
Davenport Rotary Steam Tube Dryer, 6'x36".
2—Stainless Steel Steam Jacketed Readco Mixers.

H. LOEB & SON

1—#316 Stainless Reactor, 265 gals. cap., jacketed.
Abbe Pebble & Tube Mill, 5'x22"—Buhrstone lined.
1—Patterson Ball Mill, porcelain lined, 17'x22".
1—Patterson Ball Mill, 42x36, jacketed.
45—Steel Tanks from 100 to 100,000 gals.
2—Large Steam Jacketed Horizontal Mixers.
Robinson Pulverizer #226, with 2 motors 10 HP each.
2—Ribbon Type Mixers 50 & 90 cu. ft.—like new.
4—Horizontal Retorts 200# w.p., A.S.M.E. from 12" to 24" dia., 4' to 12' long.
2—Crystallizers—10' long.
3—3,000 gal. Jacketed Kettles with Turbo Agitators.
1—210 Day 300 gal. jacketed Sigma Blade Mixer.
1—Sparkler Stainless Filter Model 18-S-23.
1—Sparkler Stainless Filter Model 35-S-9.
3—2500 gal. Pfaudler G/L Tanks & S/S Agitators.
6—Blackburn-Smith Jacketed Filters, 20 to 160 gpm.
1—Jeffrey Vibrating Conveyor, 15' long.
4—Hoffman Steam Jacketed Filters.
1—Meade Mill #2 with 7 1/2 H.P. Motor.
4643 LANCASTER AVE., PHILADELPHIA 31, PA.

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Hopper Cars - Tank Cars
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50 and 70 ton
Capacities
Tank Car Storage Tanks
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Locomotive Cranes

Tank Cars Repaired - Major or Minor - and LITHCOTE lined, in our modern and well-equipped plant at Landisville (Lancaster Co.), Pa.

RAIL & INDUSTRIAL
EQUIPMENT CO., Inc.

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RR Yard & Shops
LANDISVILLE, PA.

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NO BETTER MACHINES AT ANY PRICE

2—UNUSED No. 12 Sweetland Filters, 48 bronze monel covered lvs. 3" ee.
3—6"x125' Rotary Kilns.
3—6"x50' D. H. Rot. Dryers, 3/4".
1—#2 Simpson Mixer, motor drive.
2—34"x70" and 1—40"x60" Bird Continuous Centrifugals, S/S Solid bowls.
2—5/8 Harey Rotary Dryers, 5x26" and 6'x23".
1—#502-16 Link Belt S/S Roto-Louvre Dryer.
1—3'x30' Bonnet D. H. Rotary Dryer & Cooler.
3—6'x50' D. H. Rot. Dryers.
1—30 gal. Stainless 347, Calandria Still, Agitated, with Condenser.
1—30 Gal. Stainless 347, Agitated Tank, Motor Driven.
9—Sperry 18"x18 Iron recessed Filter Presses, 18 chambers.
3—480 gal. S.S. Steam Jkted. Kettles.

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1—Bufflovak 48"x40' Drum Flaker, chrome plated, S/S ends.
1—Oliver Rotary Acid Filter, 6'x6'.
4—Mejonnier, S.S. Van. Pans, 3', 5', 6'.
3—6'x50' L'ville Rot. Tube Dryers.
1—Day size 30 Imperial Jacketed 75 gal., Sigma Blades.
1—4TH, Mikro Pulverizer, 60 H.P., t.e.f.c.
4—Bufflovak Atmo. Dbl Drum Dryers 24"x36", 32"x90", 42"x120".
3—Anco 4'x9' Chilling Rolls.
5—Horiz. Ribbon Dry Mixers, 4000 lb., 1500 lb., 500 lb.

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- 1—Fletcher Susp. 40" dia. Imperf. Basket, Steel
- 1—Tolhurst Susp. 26" dia. Imperf. Basket, Steel
- 1—Bird 36" x 50" Solid Bowl, Steel
- 1—Bird 24" x 24" Horiz. Steel
- 6—DeLaval Nos. 74-11; 94-01; 600, LA-11

CONDENSERS—EXCHANGERS

- 10—St. St., Shell & Tube—to 900 sq. ft.
- 4—St. St. Coil type—40 & 55 sq. ft.
- 8—Steel, Shell & Tube—785, 446, 335 sq. ft.

DRYERS

- 4—Devine #27 Vacuum Shelf, 475 sq. ft.
- 1—Devine #23 Vacuum Shelf, 365 sq. ft.
- 2—Devine Vacuum Shelf Dryers, size 17, 80 sq. ft. UNUSED
- 1—St. St. Spray Dryer, 19" dia. x 20' high, with Western Precip. nozzles, fans, oil burners, etc.
- 1—Bowen 5' dia. Stainless Steel Spray Dryer
- 1—Bowen St. St. Lab. Spray Dryer
- 1—Stokes 3' dia. x 15' long Jacketed Rotary Vacuum Dryer
- 4—Double Drum Dryers: 42" x 120"; 24" x 60"; 24" x 36"; 22" x 38"
- 8—Rotary Hot Air Dryers or Kilns: 5'6" x 50', 4'6" x 40', 3' x 24'
- 1—Rotary Dryer 10' x 100' x 3/4"
- 2—Rotary Coolers: 104" x 30' and 104" x 70'
- 1—B & S Rotary Hot Air Dryer, 3' x 15', Everdur
- 3—Rotary Furnace Tubes 24" D x 8'6" L x 3/4" Chrome nickel Alloy
- 1—Hardinge XC-2 Ruggles Coles Rotary Steam Tube Dryer, 4' D x 30' L
- 2—Davenport Rotary Steam Tube Dryers, 6' dia. x 40' long
- 2—Davenport size 2A Dewatering Presses
- 2—Swenson Walker Crystallizers, steel, jacketed, each 30' long.

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- 1—Goslin-Birmingham 6775 sq. ft. Quadruple Effect, Vertical, Long copper tubes
- 1—Conkey 1900 sq. ft. Triple Effect, Vertical long Hercules tubes
- 1—Bufflovak size 6.5 model 629D Double Effect, all stainless steel, 588 sq. ft.
- 1—Stainless Steel, 145 sq. ft. coil, 500 gal.
- 1—Stokes 150 gal. St. St. Jacketed Vacuum Still
- 15—Columns—Aluminum, Copper & Stainless Steel

KETTLES

- 3—Bartlett-Snow 6' dia. x 3' deep Jacketed Stainless Steel Mixing Kettles
- 4—St. St. closed—to 450 gal.
- 20—St. St. open top—to 550 gal.
- 5—Aluminum, closed, 35 to 250 gal.

AUTOCLAVES

- 2—Blow Knox 1/2 gal. St. St. agit. 2000# Pr.
- 3—St. St. T347, 13 gal. 1400# test, 50# jkt.

FILTERS

- 1—Bird 40" x 60" Contin. Centrifugal Filter
- 2—Eimco 10' x 12' Rubber Covered Filter
- 3—Sweetland Filters: #12 (72 lvs.); #5 (20 lvs.); #2 (18 lvs.)
- 2—Oliver 5'3" dia. x 8' F Continuous Panel Type Filters, gas tight hoods and repulpers—UNUSED
- 1—Swenson 8' x 8' Rotary Vacuum Filter, Precoat type. Acid proof construction
- 5—Cast Iron Filter Presses, 30" x 30" open delivery, 28, 35, and 50 chambers
- 4—Filter Presses, closed delivery, 12" to 36"

MILLS

- 2—Hardinge Contin. Ball Tube Mills, 7' x 9' and 6' x 12'
- 1—Patt. Fdy "DJ" Unlined Jacketed Steel Ball Mill, 6' dia. x 8' long—UNUSED
- 4—Pebble Mills 6' D x 8' L, 45" x 42"
- 1—Al. Ch. 6' D x 16' L Steel Lined Contin. Ball Mill
- 3—4'6" D x 12' L contin. Pebble Mills
- 1—Hardinge 6' D x 22" L Conical Ball Mill, Steel Liner
- 1—Charlotte #50 Colloid Mill, 75 HP
- 1—Penna Ring Type Granulator, Trojan K3-24, 40 HP
- 3—Fitz. Mill St. St., F-8, K D
- 5—Hammer Mills: Jeffrey 42 x 36; Gruendler 36 x 24; Jay Bee 75 HP; Williams 14" x 14", Williams size A, St. St. and Aluminum
- 1—Sturtevant 8 x 10 Jaw Crusher
- 3—Attrition Mills, 30", 24" & 16"
- 1—Pug Mill, St. St., two 7" dia. overlapping chambers 3'9" L. Jktd.
- 3—Mikro Pulverizers # 2-DH, 2-TH, 3-TH

MIXERS—BLENDERS

- 3—Readco Heavy Duty Double Arm Sigma Blade Jacketed Mixers 50 gal. work. cap. 30 HP Expl. Pr. Motor. Built 1951-53
- 4—Sprout Waldron size 12 Ribbon Mixers, 336 cu. ft. work cap.
- 2—W & P Sigma Blade Double Arm Jacketed Mixers, 100 gal. work cap.
- 1—Patt. Kelly St. St. Twin Shell Blender, 5 cu. ft. work. cap.
- 9—Side Entering Stainless Steel Mixers, 7 1/2 HP, 10 HP, 15 HP & 25 HP
- 3—Falk Vertical Agitator Drives #10-GDX, 10:1, 300 HP—UNUSED.
- 10—Turbo Vertical Drives, #5B, 5:1, 40 HP

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- 1—AC-Pump, #3126
- 1—M-100 Pump, #3166

TANKS

- 12—Aluminum, 3000 gal., 5 compart.
- 10—Aluminum, 500 gal., 80# WP.
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- 1—St. St., T304, 1/8" 10,500 gal. Horiz.—UNUSED
- 1—St. Clad, T304, 3/8", 6500 gal. Vert.
- 1—St. St. T316, 5/16", 4000 gal. Hor.
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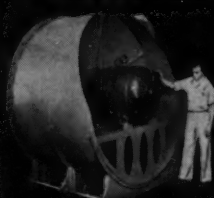
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8—11'6" x 16' OLIVER CONTINUOUS DRUM
FILTERS

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FILTER Eimco Rotary Vacuum Filter; 8'x8'

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 - Day Hercules Spoke Crusher 1 1/2 H.P. motor.

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APRIL 1956

PRODUCTS INDEX

Chemicals and raw materials.....	420
Equipment and accessories.....	420
Processes and services.....	430

GUIDE TO TECHNICAL LITERATURE

Chemicals and materials.....	432
Construction materials.....	436
Electrical equipment	438
Handling and packaging.....	442
Heating and cooling.....	443
Instruments and controls.....	445
Mechanical equipment	438
Pipe, fittings and valves.....	449
Process equipment	454
Pumps, blowers and compressors.....	459
Services and processes.....	465

INDEX OF ADVERTISERS

Alphabetical list of firms in this issue.....	466
---	-----

CHECK LIST OF REPRINTS

Editorial reports and other reprints.....	472
---	-----

READER SERVICE POSTCARDS

Get more information—fast.....	Inside cover
--------------------------------	--------------

Products Index

• Your complete index to chemicals, materials, equipment and services taken from this issue's advertisements, new products departments and "Guide to Technical Literature."

• Products listed feature code numbers which show the page on which they appear. L (left), R (right), T (top), B (bottom) indicate ad location; A, B, C, etc. and a, b, c, etc. identify specific product items on an editorial page or in an ad.

• You can get information on any listings by circling its key number on the Reader Service Postcard (see inside back cover). Replies will come direct from the companies manufacturing the products.

Chemicals

Acid
Adipic432A
Anhydrous, hydrofluoric...98a
Monohydrate, p-toluene
sulfonic432B
Acids, fatty48-9
Acrolein432C
Additives, lubricant150J
Alcohol
Anhydrous35-6b
Isooctyl151
Polyvinyl340-1a
Tetrahydrofurfuryl,
bulletin 87C425
Alcohols, fatty432D
Alumina, trihydrate432E
Bisphenol111
3,3'-Bitolylene
4,4'-diisocyanate432F
Boron trifluoride98b
Carbon, activated383, 432G
Carbonate of potash21g
Catalysts432H
ChemicalsBL357, 380
Automotive150B
Custom-made149
Metal finishing,
bulletin 61119b
Odor control432I
Textile432J
Chlorine, liquid21a
Chloromethanes147
Cyclohexanone, bulletin 1-19...401
Dichlorobenzene,
bulletin 454154a
Diisocyanates432K
Expoxides340-1b
Ethanolamines121
Fluids & lubricants,
synthetic432L
Formaldehyde340-1c
Fungicides, apple148E
Glycerine241

Greases, semifluid synthetic...150H
Gum, karaya432M
Hardeners, liquid, epoxy146D
Inhibitors, corrosion144A
Inks, vinyl432N
Latexes434A
Nitrile434B
Lithium hydroxide434C
Lubricants, siliconeR353
Methionine35-6c
Miticide150D
Molding compounds, nylon...434D
Molybdenum silicides434E
Monomer, vinyl acetate145
Nitrocellulose82
Nitroparaffins333
Oils, castor434F
Oxides, chromium328
Paints, silicone150A
Paradichlorobenzene21c
Paraffins, chlorinated434G
Pesticides, granular434H
Plasticizer, low-volatility ...150C
Polyethylene123, 434I
Poly resins, electric-grade...150E
Potash, caustic21b
Potting compound, epoxy-
based1501I
Pyridine142A
Quilon chrome complex146C
Reagents, chromatographic...150F
Resins363
Coumarone-indene79
Epoxy435-A
Hydrocarbon435B
Para coumarone indene435C
Polyester154b, 435D
Polyethylene...146B, 385a, 435E
Polyvinyl chloride435F
Styrene-butadiene435G
Tetrafluoroethylene385b
Vinyl12
Salt152
Scale preventive146A
Silica435H

Soda ash43
Soda, caustic21d, 154c
Sodium citrate, bulletin 68...119a
Sodium dispersions340-1d
Sodium hydride oil dispersion.435I
Sodium m-silicateBR421
Sodium toluene sulfonate...436A
Spray, live stock436B
Stabilizers436C
Sulfur dioxide, liquid42
Tetrachloro phthalic anhydride.21f
Tetrahydrofuran340-1e
Tolylene diisocyanateisomeric
mixture436D
Trichlorethylene21e
Vinyl propionate148D

Equipment

Absorbers, catalog S-7460...225f
Accelerators, particle240A
Agitators454A
Air conditioners33
Alarms, gas252B
Alloys436E
Exhaust valve436F
Aluminum37
Brazing436G
Analyzers445F
Infrared317
Automation445G
Bag packers442A
Batteries, flat-plate438D
Belting, conveyor442B
Belts
Conveyor, hot-material19
V-360
Blenders334
Blowers, bulletin B-154...444
Boilers39
Burners
Dual stage, bulletin 125...R351
High velocity, bulletin 110.R455
Carriers
Catalyst83
Straddle242D
Castings, high alloy458
Centrifugals, continuous423
Centrifuges, bulletin 1257...129
Clays, rotating roll442C
Classifiers & dryer.....454B
Classifiers, powder236A
Cloth, filter462
Coatings
Industrial277
Protective233
Silicone, heat resistant...R433
Surface resistant150G
Columns, distillation92
CompressorsR453, 459E
Bulletin CRC-1056
Bulletins 16B8244, 16B8126.307
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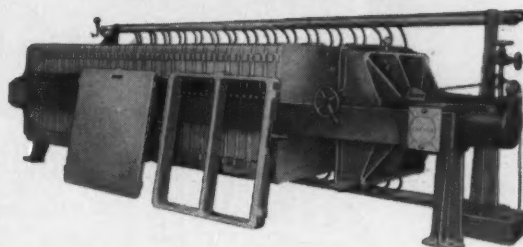
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Balanced opposed, bulletin	
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Centrifugal	377
Oil fire, bulletin 57-11	8
Rotary	65
Computers	31
Condensers, barometric	443E
Controllers, temperature	207
Controls	217
Corrosion	440
Process, bulletin 13-18	44-5
Temperature	445H
Catalog 200	320
Catalog 1531, bulletin 8420	376
Conveyors	350, BL439
Sectional belt	442D
Steel, galvanized	442E
Coolers	
After	443F
Cascade	465c
Catalog S-6820	225e
Rotary, water tube,	
catalog A	TL343c
Copper	257
Corrosion proofing materials	436H
Couplings	L332
Coverings, pipe	250B
Crushers	BL359
Crystallizers	6-7c
Cylinders, gas	BL353
Discs, rupture	319, 465e
Demineralizers	454C
Demisters	456AA
Dissolvers	379
Salt	238B
Drives	
Bulletin C220-M542	316
Gear	25b
Motor	477
V-belt	438E
Drums, steel	90, 242C
Drums & barrels	15
Dryer-blenders	211
Dryers	215, BL433, TL441
Coolers, roasters	378
Hot air & direct fire,	
catalog A	TL343b
Horizontal	240E
Lectrodryer	390
Pilot	240B
Spray	6-7a, 240D
Bulletin 373	364
Drying equipment	24

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PRODUCTS . . .

Drying systems, flash, catalog 82	314
Dust collectors, BL355, 456A, 456B Centrifugal	86
Cloth tube, catalog 372	18
Water wash	BR439
Dust control	222
Eductors, water jet	456C
Ejectors	454
Steam jet, bulletin W-205- E21	223
Electrical equipment	251
Electrodes, welding	437A
Eliminators, mist	325
Bulltin ME-106	29
Evaporators	6-7b, 387
Expanders, tube, bulletin 55	300
Fabricated equipment, stainless steel	17
Fabricated products Polyethylene & polyvinyl chloride, bulletin AA-3	R343
Steel & aluminum	L453
Fabrication Steel	366, 449
Steel & alloy	437B
Fans	428, 460A
Bulletin DB-37-55	209
Industrial, bulletin 5306-H	41
Rubber lined, bulletin 702-A	61
Ventillating, bulletin F-100	66
Feeders Continuous weigh, catalog 841	384
Rotary airlock	442F
Feeders & vibrators	97
Fillers, liquid	BL343
Filters	6-7d, 57
Catalog SAK-057	254
Bulletin 111	337
Centrifugal, continuous	11
Pressure leaf, catalog NC-1-53	422
Finishes Auto	148B
Industrial maintenance	437C
Silicone	148A
Fittings	133
Stainless steel	TL439
Welding	10
Fittings & flanges, polyvinyl chloride	449D
Tractometer, vapor	112
Freight car	242A
Gages	386
Filter	446A
Liquid level, catalog 35	374
Reflex	R357
Gasket materials, bulletin CE46	324
Gaskets High pressure	143

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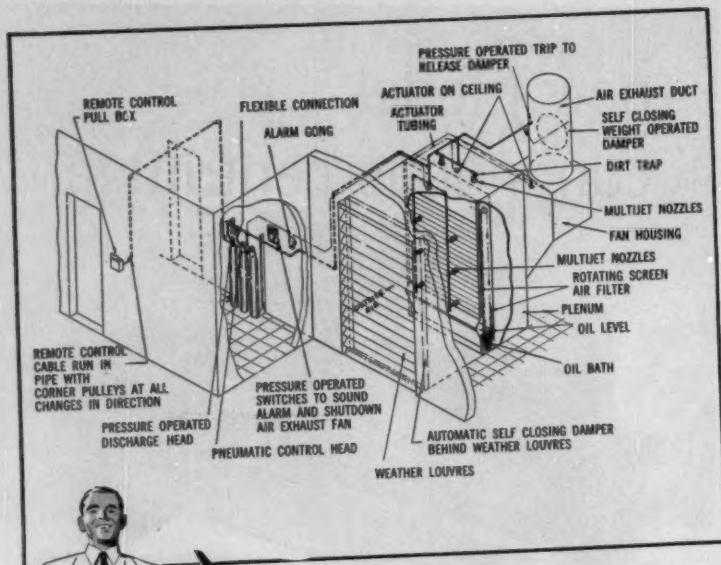
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Kidde systems have no falling weights, use no clumsy mechanical triggering methods. Pneumatic or Electrical Control Heads insure instant and complete CO₂ discharge. All moving parts of a Kidde system are self-enclosed for safety, need no replacement after a fire, have easy-to-read indicators which show at a glance whether system is "set" or "released." What's more, special Directional Valves let you guard more than one hazard from the same cylinder bank, giving you the most *versatile* protection on the market today!

It's easy to get the *best* in fire protection. For information about *your* specific problems, write Kidde today.

Kidde

Walter Kidde & Company, Inc.
428 Main Street, Belleville 9, N. J.
Walter Kidde & Company of Canada, Ltd.,
Montreal—Toronto

The words 'Kidde', 'Lux', 'Lux-O-Matic', 'Fyre-Freeze' and the Kidde seal are trademarks of Walter Kidde & Company, Inc.

PRODUCTS . . .

Teflon	312
Generators	
Inert gas, bulletin 1-10	253
Steam	221
Bulletin 586	271
Grating & stair treads, bulletin 2486	467
Heat exchange equipment	430
Heat exchanger units, shell & tube	395
Heat exchangers	438, 444A, 444B, 444C, 444D, 465b, 478c
Catalog S-6740	225c
Catalog S-6800	225d
Heat transfer apparatus	444E
Heat transfer equipment	105
Heaters	71
Air, literature H54-15	L463
Gradation, bulletin 114	20
Radiant	444F
Steam water	444G
High pressure equipment, catalog 406-D-34	BL351
Hose	22
Hose & belting	449E
Hot oil systems, electrically heated	445A
Indicators, vertical scale	446B
Inspection, ultrasonic	446C
Instrumentation, bulletin P1245	234-5
Instruments	
Industrial	TL359
pH	252A
Insulation	
Block	46
Epoxy	148C
Glass fiber	95
Pipe & Block	437D
Intensifiers & pumps, high pressure	460B
Ion exchangers	219
Jacketing, aluminum	282
Joints	
Ball	452
Expansion	449F, 449G
Rotary pressure	449H
Swing, catalog F-8	298
Kettles, dimpled jacket	478b
Kilns, rotary, bulletin 1115	362
Laboratory equipment	BL441
Laboratory glassware	465C
Laminate, polyvinyl chloride, flexible-rigid	437E
Lining material	250C
Polyvinyl chloride	437F
Lubrication systems	127, 239
Magnets	442G
Permanent	442H
Metals	460
Meters	
Book 566S	450



'scuse us
for being chesty, but...

... we just can't help crowing about reader-response to CE's *Annual Inventory Issue*.

A chemical engineer from Brooklyn calls it . . . "invaluable already, and without precedent." A South Carolina plant manager stopped in to tell us . . . "Yo'all done yo'self real proud." A Dallas man swears . . . "the editor musta come from Texas."

Others went into greater detail—on content, arrangement of editorial sections, Reader Service—even the quality of the advertising. Comments and opinions were all over the lot. And they're still coming in.

What do you say? It's your magazine and we're wide open for suggestions. We'd like your ideas . . . for the *1956 Annual Inventory Issue* of **CHEMICAL ENGINEERING**.

ANNUAL INVENTORY ISSUE

**Chemical
Engineering**



A McGraw-Hill Publication, 330 W. 42nd St., New York 36, N. Y.

CHEMICAL ENGINEERING—April 1956

No. 1 in a series | Successful Uses of QO THFA® (TETRAHYDROFURFURYL ALCOHOL)



ESTER QUEST YIELDS A NONVOLATILE HERBICIDE

(Photos courtesy of California Spray-Chemical Corporation)



Typical agricultural application of an Ortho® herbicide

Company: California Spray-Chemical Corporation, Richmond, California, makers of Ortho® herbicides.

Problem: To produce a nonvolatile herbicide that clings to brush and weeds until they're killed and control possible vapor injury to adjacent sensitive crops.

Solution: 2,4-Dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) are converted to tetrahydrofurfuryl alcohol esters which have low volatility and contain maximum percentages of 2,4-D and 2,4,5-T components for effective herbicidal activity.

End Product: A nonvolatile, effective herbicide that stays put longer.

Side Benefits: (1) THFA is easy to esterify and handle. (2) The resulting THFA esters of 2,4-D and 2,4,5-T are easily soluble in the majority of organic solvents and insoluble in water.

Check Into THFA yourself. Its successes are numerous. THFA is a versatile solvent for many resins and dyes, a useful chemical intermediate and finds a large market in the synthesis of plasticizers for vinyl resins.



Write for
Bulletin 87C on THFA

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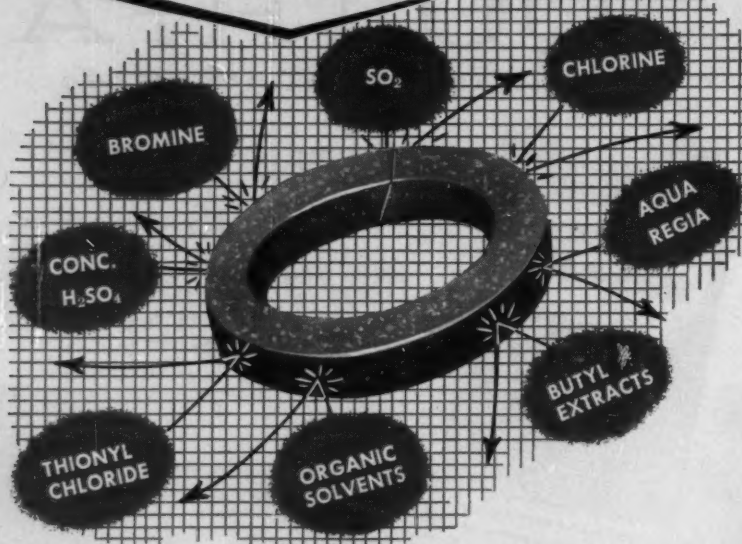
The Quaker Oats Company

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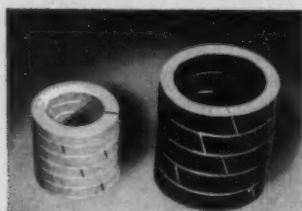
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**If you pump these
corrosives ...**



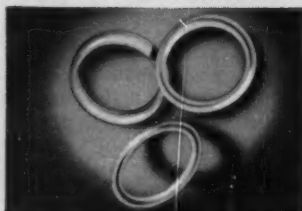
Get months of Trouble-Free service with CHEMPRO TEFLON PACKINGS

If your pumps and valves handle highly corrosive industrial chemicals, CHEMPRO TEFLON PACKINGS will drastically cut packing replacement and maintenance costs. CHEMPRO Packings last for many months under corrosive conditions which make ordinary packings useless in days or even hours. They stop leakage by providing a tight seal at only slight gland pressure, and their very low coefficient of friction often makes lubrication unnecessary.



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Millisecond	446D
Moisture	446E
Mills	457A
Ball & pebble, catalog 73 & 77	442
Disc roll	457B
Roller	25a
Mixers	23, 335, 369, 458A
Bulletin B-107	203a
Bulletin B-109	203b
Bulletin 800	339
Catalog 26	372
Laboratory, bulletin B-112, ..	203c
Paper coating	321
Portable, bulletin B-108, ..	203d
Side entering, bulletin B-104 ..	203e
Top entering, bulletin B-102 ..	203f
Propeller type, bulletin B-103 ..	203g
Molding machines	205
Monitors, fail-safe	252E
Motor starter circuit-breakers, ..	91
Motors, bulletins MU203, MU132 ..	72
D C	244A
Explosion proof	L455
Bulletin 1700	388
Gear	246A, 440A
Sealed	246D
Motors & controls,	254A-B
Motors & generators,	440B
Nozzles	TR429
Catalogs 6A, 6C,	R359
Spray, catalog 24,	TL353
Packaging	
Collapsible tube	442I
Corrugated	443A
Packings	352a
Pump, catalog TP-1255, ..	352b
Teflon, bulletin PE-321, ..	344
Packings & gaskets,	426b
Panels, radiant	445B
Papers	85
Autopositive	68
Pellets, continuous	247
Pilots, temperature	457
Pipe	
Lead lined	131
Plastic, bulletin CE-56, ..	326-7a
Bulletin 80	326-7e
Polyvinyl chloride	450A
Saran lined	64
Pipe & fittings	
Catalog S-7000	225b
Lectro-clad	354
Pipe & tubing,	84
Plastics	139, 437G
Potentiometers	252D
Preheaters, air	80

PRODUCTS . . .

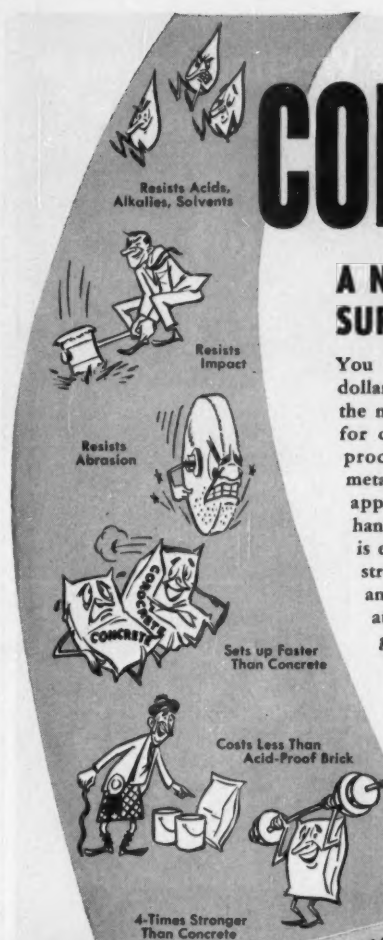
Presses, dewatering, catalog A	TL343a
Process equipment	62-3, R355
Fabricated, bulletin 550	153
Impervious graphite .225g, 465a	
Processing equipment	125, 342
Liquid	459A
Proportioning systems, bulletin 0351	74
Pulleys	
Reduction	246B
Variable speed	L461
Pulverizers	240F, 431
Pumps	237, TL355, 462A
Bulletin CE	47
Bulletin Hc	TL351
Bulletin S-147	L429
Catalog 5206	TR439
Acid	81, 462B
Bulletin CE-55	326-7d
Submersible	462C
All purpose	248C
Centrifugal	157, 331, 356, 465d
Catalog S-7250	225a
Catalog 184B	R461
Sealless	462D
Chemical	464A
Bulletin W-350-B-13	54-5
Bulletin 725.4	266
Bulletin 982	436
Condensate & vacuum	464B
Diaphragm slurry	464C
Direct flow	459
Double end	248B
Drum	TL433
Electromagnetic	140-1
Filter	240G
Fire	464D
Gear	464E
Heavy duty	288-9
High pressure	464F
High vacuum, bulletin 403	299
Leakproof	248D
Liquid oxygen, bulletin 203-7	443
Process, bulletin 1125-B	243
Proportioning	248A
Rotary	434
Vertical turbine	93
Wet pit	465A
Radiation	446F
Reactors	TR421, 240C
Glassed steel	478a
Reclaimer systems, oil, bulletin	
R-160	346
Recorders, Spec. E12-5	301
Temperature	R345
Recovery system	238C
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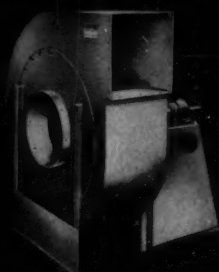
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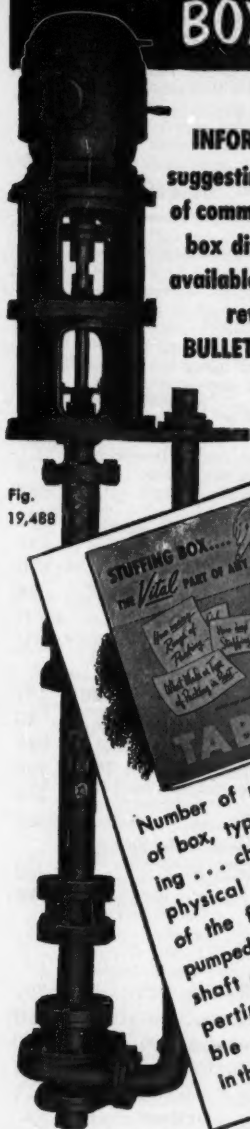
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Rubber, synthetic	438B
Safety equipment	336
Scales, truck, bulletin 2417	318
Scanning & logging systems, bulletin 98268	76
Screens, vibrating	238A
Scrubbers, fume	459B
Seals	
Catalog 455-CE	TL345
Mechanical rotary, bulletin B-111	203h
Shaft	R441
Separators	396
Laboratory	330
Sifters, gyratory	245
Spectrometers, mass, bulletin CEC1824B-X2	367
Starters	274
Steels	
Alloy & stainless	438C
Stainless	58-9, 249, 287
Steels & plastics	158
Surfacing	
Floor	427
Hard	250A
Tank cars	73
Tank equipment	459C
Tantalum	446
Teflon products, bulletin CP554	426a
Telemetering, logging & reporting systems	449B
Thermostats, electric	449C
Thickeners, bulletin 31-D-11	322
Titanium	88
Trailers	
Bulk	242B
Gas supply	TR332
Transformers, arc furnace, bulletin GEA-6236	53
Transmitters, pressure	38
Traps	
Pumping & lifting	459D
Steam	
Bulletin 10-55	349
Bulletin T-1739-X	365
Trucks	
Fork lift	443C
Industrial	443D
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Bulletin 1954	368

PUMP STUFFING BOXES



INFORMATION
suggesting solution
of common stuffing
box difficulties;
available in newly
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BULLETIN S-147

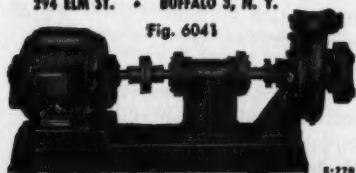
Fig.
19,488



Number of rings, depth
of box, type of pack-
ing... chemical and
physical properties
of the fluid being
pumped, speed of
shaft and other
pertinent usa-
ble facts are
in this Bulletin.

WRITE on business stationery for your
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Fig. 6041

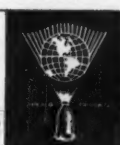


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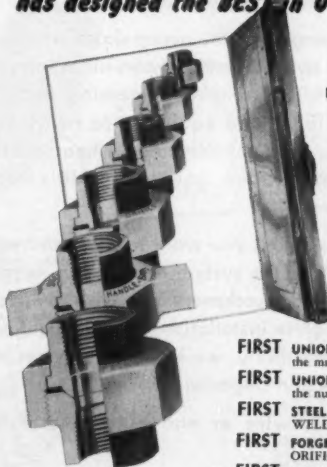
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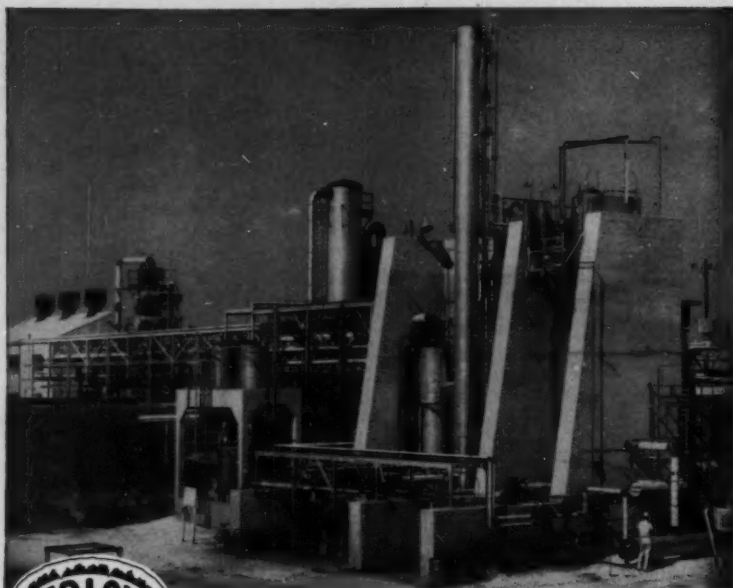
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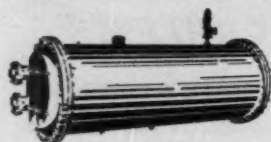
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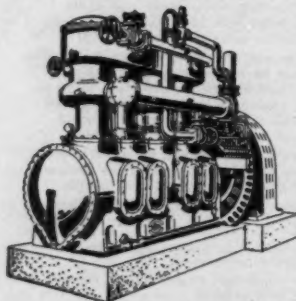


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Frick compressors are manufactured in 83 types and sizes to fit every cooling requirement.

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Valves	BL345, 452A
Bulletin 1000	87a
Air control	452B
Alloy	222A
Cylinder	155
Diaphragm	16, 229
Bulletin 351	326-7c
Drain	L421
Gate	94, 338
Catalog 10	14
Globe	452C
Iron gate	381-2
Lubricated plug	347-8
Catalog PV-4	51
Book 39-5	156
Needle	445
Pinch	78
Porcelain	361
Roto	R463
Solenoid	231
Steel gate, bulletin 195	87b
Steel plug, catalog 55-1-W	89
Vaporizers	445D
Dowtherm	445E
Vessels	
Pressure	222B, 437
Processing	60
Viscometers	329
Washers, fume, bulletin FW-4	102
Wire cloth	456, 468
Catalog 50	BR332
Wires, thermocouple & extension, bulletin 31-E	469
X-ray TV	246E

Services

Chemical cleaning	392
Copy makers	465B
Design & construction	2, 69
Methanol units	137
Engineering & construction	67, 117
Engineering services, electrical, bulletins GED-2244 & GED-1966B	100-1
Fire protection	424
Gaging charts, alcohol drum	35-6d
Information systems	290
Laboratory service	465D
Research	465E
Research & development	465F
Sodium handling, metallic	443B
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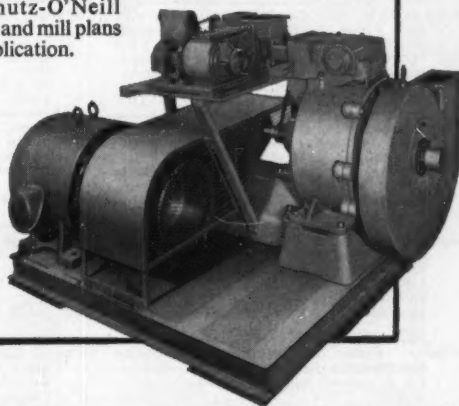
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Chemicals

Acid, Adipic......Comprehensive 8 p. reference gives physical & chemical properties; principal reactions on the carboxyl & alpha methylene groups; solubility curve, & suggested uses; etc. Technical Bulletin 1-12.
432A National Aniline Div.

Acid Anhydrous, Hydrofluoric......40 p. book contains valuable information concerning hydrofluoric acid anhydrous. Provides useful data for those who now use HF, or for those who are contemplating its use.
98a Harshaw Chem. Co.

Acid-Monohydrate, p-Toluene Sulfonic.....Technical Bulletin contains detailed information on toluene sulfonic acid-solid (high para) & para-toluene sulfonic acid-monohydrate. Includes specifications & reference literature.
432B Hydrocarbon Chem.

Acids, Fatty......Armour's 2-system fractionation assures you of uniformity & highest purity in Neo-Fat fatty acids. "The Chemistry of Fatty Acids," 48 p. brochure, & Specification Chart is available upon request.
48-9 Armour Chem. Div.

Acrolein......Issues a new data folder on Acrolein. Includes: physical properties; shipping data; applications; typical reactions; derivatives of acrolein; physiological properties; etc. 24 p. Ref. No. F-7389C.
432C Carbide & Carbon Chem.

Alcohol, Polyvinyl......Just a small amount of Elvanol is all that is needed to make highly stable dispersions or emulsions of mineral and vegetable oils, many resins, waxes, organic solvents, etc. Complete information.
240-1a E. I. du Pont de Nemours.

Alcohol, Tetrahydrofurfuryl......THFA (tetrahydrofurfuryl alcohol) is the starting point for the preparation of high boiling tetrahydrofurfuryl esters and ethers. Product sample and Bulletin 57C upon request.
425 Quaker Oats Co.

Alcohols, Fatty......"Survey of Cachalot Brand Fatty Alcohols," a new 12 p. booklet, describes large line of straight-chain aliphatic alcohols. Includes properties, applications, typical reactions, solubilities, etc.
432D M. Michel & Co.

Alumina Trihydrate......Presents valuable technical information and product samples of low-iron, organic free alumina trihydrate. Uses include: iron-free alum; high quality glassware; iron-free catalysts; etc.
432E Reynolds Metals Co.

3,3'-Bibutylene 4,4'-Diisocyanate......Technical information available on Nacconate 200. Includes: typical analysis; chemical properties and suggested uses; physiological properties; etc. Technical Bulletin 1-17D.
432F National Aniline Div.

Carbon, Activated......Illustrated, 6 p. Folder contains descriptive information on Girdler Activated Carbon G-32. Includes: numerous applications; characteristics and properties of activated carbon; etc.
432G Girdler Co.

Catalysts......"Harshaw Catalysts Made to Your Specifications" includes sections on: the history of catalysts; typical Harshaw catalysts and how they are used; catalytic chemicals supplied by Harshaw; etc. 8 p.
432H Harshaw Chem. Co.

Chemicals, Custom-Made......More than 1,000 high purity chemicals are manufactured by B & A. Available in quantities ranging from small bottle lots of laboratory reagents to carloads of fine chemicals. Catalog.
149 Baker & Adamson.

Chemicals for Metal Finishing......Chemicals of interest to metal finishers include: citric, tartaric, gluconic, & oxalic acids, & their salts. Request Technical Bulletin 61, "Chemicals for Metal Finishing."
119b Chas. Pfizer & Co.

Chemicals, Odor Control......Issues a new Bulletin on the use of "Alamask" odor control chemicals in rendering operations. Describes use in cookers processing butcher & slaughter house scrap & chicken offal, etc.
432I Rhodia, Inc.

Chemicals, Textile......New 26 p. technical reference reviews some of the newer uses for chemicals for the textile industry. Features Niatex anti-static AG-2, a new finish for textiles. Request your copy of Booklet F-8679B.
432J Carbide & Carbon Chem.

Chloromethanes......Valuable data on diverse uses & physical & chemical properties of chloromethanes—methylene chloride, methyl chloride, chloroform, carbon tetrachloride—in new, comprehensive 28 p. reference.
147 Solvay Process Div.

Cyclohexanone......A new source—a new name for cyclohexanone—National Nadone. It is now available from basic production. For complete information, company offers a sample and 24 p. Bulletin No. 1-19.
401 National Aniline Div.

p-Dichlorobenzene......Made in seven different sizes. Each size has its advantages—tops for repackaging & the crystals make a firm, dry, non-oiling block or pellet of exceptional whiteness. Bulletin 454.
154a Hooker Electrochem. Co.

Diisocyanates......24 p. reference describes "Nacconates" National aniline diisocyanates. Includes: physical properties; chemical properties; suggested uses; physiological action; storage; etc. Technical Bulletin 1-17.
432F National Aniline Div.

Epoxidation with H₂O₂......Literature and data on epoxidation technique for natural fats, oils and derivatives. New method increases epoxy content; lowers by-product formation; eliminates preforming peracid; etc.
340-1b E. I. du Pont de Nemours.

Ethanolamines......Company makes available samples, quotations and literature on Ethanolamines. Includes information on its uses, physical properties tables & graphs, etc. Complete details sent upon request.
121 Nitrogen Div., AC&D.

Fluids & Lubricants, Synthetic......Issues a new 52 p. booklet on Ucon synthetic fluids & lubricants. Covers properties, applications, and characteristics of these polyalkylene-glycol derivatives. Request Form No. F-65001.
432L Carbide & Carbon Chem.

Formaldehyde......High purity 50% and 37% formaldehyde is available at low cost from Du Pont. Its methylene (—CH₂—) group functions as a "chemical button" to link similar or dissimilar molecules. Request data.
340-1e E. I. du Pont de Nemours.

Glycerine......Offers valuable booklets including: "Glycerine Alkyls Tailored to Need" (20 p.); reference on glycerine standards & specifications (8 p.); booklet covering properties & applications (16 p.).
241 Glycerine Producers' Assoc.

Gum, Karaya......A thickener in printing, finishing and sizing. Other uses: in pharmaceuticals as an emulsifier; in ceramic clays, candy and ice cream as a binder. Available in natural or powder form. Special Bulletin.
432M Jacques Wolf & Co.

Inks, Vinyl......The R. P. Series of Vinyl Inks are solutions of especially compounded vinyl compounds, containing vinyl copolymer resins, fillers and colors. For further information, request Bulletin No. 02-69-1-1-56.
432N Harwick Standard Chem. Co.

Contents of This Issue . . .

Chemicals and materials	432
Construction materials	436
Electrical equipment	438
Handling and Packaging	442
Heating and cooling	443
Instruments and controls	445
Mechanical equipment	438
Pipe, fittings, valves	449
Process equipment	454
Pumps, blowers, compressors	459
Services and Processes	465

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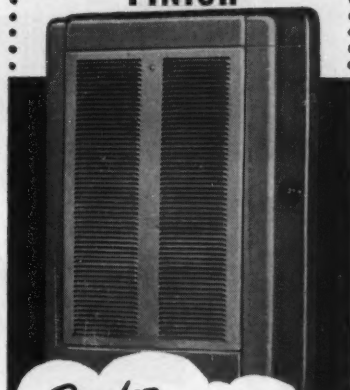
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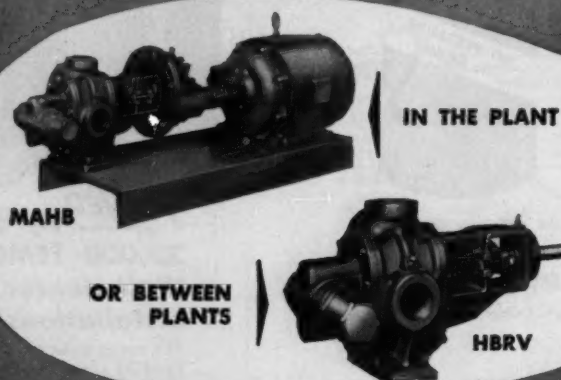
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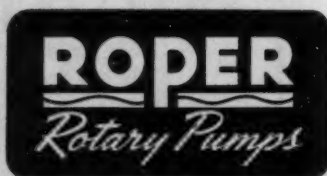
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LITERATURE . . .

Latices. Presents a new 16 p. reference on use of Hycar latices in textiles. Features a chart showing the physical properties of Hycar latices & typical fields of application for each. Request Service Bulletin H-20.
434A B. F. Goodrich Chem. Co.

Latices, Nitrile. Describes Chemigum Latex 236 & 246—small particle size nitrile latices. Sections include: analysis of properties; why small particles; small particle colloid stability; etc. Ref. No. 55-189.
434B Goodyear Tire & Rubber Co.

Lithium Hydroxide. Presents an informational Bulletin on "Trona" lithium hydroxide. Pamphlet provides valuable data on potential uses, results of laboratory tests on lithium base greases and other material. . .
434C American Potash & Chem. Corp.

Lubricants, Silicone. Cut your valve maintenance with Dow Corning valve seal, the non-melting, chemical-resistant silicone lubricant. Effective at temperatures from -40 to 500 F. Sample available upon request.
R3LS *Dow Corning Corp.

Molding Compounds, Nylon. Presents molding characteristics & physical properties of new Plaskon nylon molding compounds 8200 & 8201 together with an analysis of the new Plaskon polyethylene lubricants. Illustrated.
434D Barrett Div.

Molybdenum Silicides. Companion publications on molybdenum silicides—Bulletin Cdb-6, entitled "Refractory Molybdenum Silicides;" Bulletin CH-23, entitled "Fabrication of Molybdenum Disilicide Parts."
434E Climax Molybdenum Co.

Nitrocellulose. Used for lacquer. Quick drying and long wearing, the versatile lacquer is the standard quality wherever the finest in finishes is sought. Request a copy of company's annual report.
S2 *Hercules Powder Co.

Oils, Castor. Catalog & Product Guide of Castor Oils & Chemical Derivatives gives uses & proposed applications for 90 castor oil products such as soaps, acids, esters. Technical information is also included.
434F Baker Castor Oil Co.

Oxides, Chromium. Most stable of the green pigments, unaffected by acids, etc., non-fading. The 4 pure chromium oxides withstand ceramic temperature; the 2 hydrated used for brilliant color. Data & samples.
328 *Williams Colors & Pigments.

Paraffins, Chlorinated. "Your Fact File On Diamond Chlorowax . . . the Versatile Chlorinated Paraffin;" lists both resinous & liquid grades available & reviews & illustrates principal industrial applications. 36 p.
434G Diamond Alkali Co.

Pesticides, Granular. Announces availability of a new issue of Attacley Pesticide Digest. Entire Digest devoted to granular pesticides in general, & granular pesticide control of European corn borer in particular.
434H Minerals & Chem. Corp.

Polyethylene. New brochure, "A-C Polyethylene for Rubber Compounding," lists the advantages low molecular weight A-C Polyethylene brings to the processing of natural and synthetic elastomers. 8 p. Samples.
123 *Semet-Solvay Petrochem. Div.

Polyethylene. Announces a new 16 p. book on Injection Molding of Tenite Polyethylene. Contains basic data about molding of Tenite Polyethylene, along with a suggested guide for correcting molding difficulties.
434I Eastman Chem. Products.

Resins, Coumarone-Indene. The special pale, low-odor coumarone-indene resin . . . prescribed for freeze-thaw stable PVAc emulsion paints . . . features valuable cost-saving advantages. Request samples & data.
70 *Neville Chem. Co.

*From advertisement, this issue

Resins, Epoxy 6 p. discusses Bakelite C-8 epoxy resins & hardeners. Production methods for processing C-8 epoxy resins are presented; also includes property data for specific resin & hardener formulation.
435A Bakelite Co.

Resins, Hydrocarbon Covers properties & specifications of resins & resin solutions & gives many specific formulations & cooking procedures for aluminum vehicles, varnishes, etc., in Tech Bulletin 219 & 203.
435B Velsicol Chem. Corp.

Resins, Para Coumarone Indene Piccoumaron is the trade name of company's line of Para Coumarone Indene Resins. Presents compatibilities, color & Melting point range of Piccoumaron. Bulletin No. 12-64-5-12-55.
435C Harwick Standard Chem. Co.

Resins, Polyester Series of Bulletins covers resins & other IC Polyester products used in hand lay-up applications such as manufacture of boats, swimming pools, large structural lay-ups, bag molding, etc.
435D Interchemical Corp.

Resins, Polyester Hetron, a polyester that handles most common acids & many organic materials & gases, wet or dry, is fire-resistant. Hetron parts burn slowly & snuff out when flame is removed. Request data.
154b Hooker Electrochem. Co.

Resins, Polyethylene Illustrated references covers Petrothene line: what is polyethylene? how is it made? what are its properties? what is it used for? how is it processed? how is it fabricated? etc. 16 p.
435E U. S. Industrial Chem. Co.

Resins, Polyvinyl Chloride Pliovio DB is the family name for a series of polyvinyl chloride resins developed & produced for their dry blending characteristics. Describes DB80V & DB90V in detailed Ref. No. 55-360.
435F Goodyear Tire & Rubber Co.

Resins, Styrene-Butadiene Detailed reference, "Types and Properties," describes Pliolite S-5. Includes information on: physical properties; chemical properties; electrical properties; etc. Ref. No. 55-325.
435G Goodyear Tire & Rubber Co.

Silica Illustrated, 8 p. Brochure contains detailed information on the new industrial chemical, Quso . . . a pure white, soft, finely divided silica. Includes data on usage and physical and chemical properties.
435H Philadelphia Quartz Co.

Soda, Caustic "Caustic Soda Buyer's Guide" contains helpful facts on economics of 50% & 73% solutions; other forms of caustic soda; capacities of tank cars & other containers; useful shipping data; etc.
154C Hooker Electrochem Co.

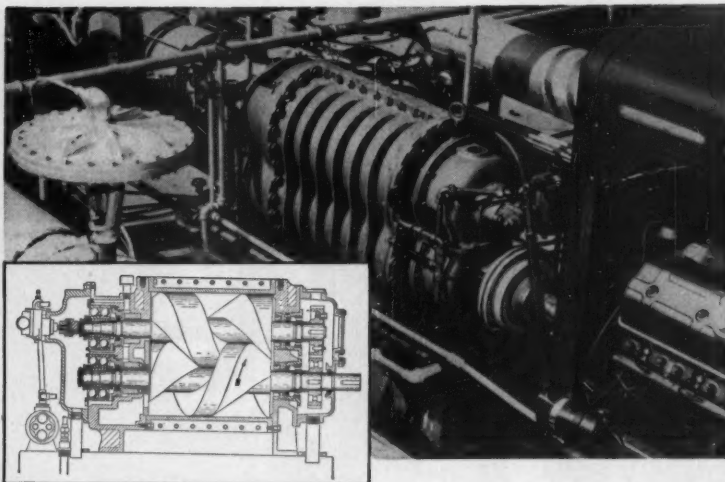
Sodium Citrate Complex-shaped interiors can be successfully plated without electricity by electroless nickel plating using Pfizer sodium citrate. Request Technical Bulletin 68, "Electroless Nickel."
119a Chas. Pfizer & Co.

Sodium Dispersions Sodium dispersions were first developed by Du Pont & are particularly useful in systems where sodium is insoluble. Request literature on sodium dispersions & how to use them to advantage.
340-1d E. I. du Pont de Nemours.

Sodium Hydride Oil Dispersion Detailed reference contains information on composition, properties, solubility, applications, typical reductions, handling, safety and storage. Request Technical Bulletin No. 508-A.
435I Metal Hydrides.

Sodium m-Silicate Valuable data on Drymet anhydrous—the most highly concentrated form of sodium m-silicate. Drymet File Folder contains complete technical information and suggested formulations.
BB421 Cowles Chem. Co.

*From advertisement, this issue



MODERN *SPIRAXIAL* COMPRESSORS

BUILT WITH R-C *plur-ability*

Users of these latest Roots-Connorsville Spiraxial Compressors tell us of their amazing efficiency and economy, at ranges of 700 cfm to 5,000 cfm, and pressures from 15 psi to 30 psi (or higher).

Then, there are these other R-C *plur-ability* advantages:

- No internal lubrication, hence oil-free air
- Direct-connected for speeds of 1750 rpm and 3550 rpm
- No water jacketing needed
- Compact—requires less space
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With many applications possible because of these advantages, we suggest you study the performance curves and other details in Bulletin SC-354. You may well find that the long-time economy of R-C Spiraxial units will justify replacing less efficient equipment.

Ask about *plur-ability* in all R-C equipment

Centrifugal and Rotary Positive
Blowers, Gas Pumps and
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this "Buffalo" pump moves your acids on rubber



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Pump with upper half of casing removed.

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If you are pumping highly corrosive liquids, or liquids containing abrasive solids, you may be paying the high price of short pump life. However, where such severe service destroys ordinary pumps in a hurry, "Buffalo" has the answer: *what acids can't touch, they can't hurt.* And in this "Buffalo" Pump, the liquid contacts nothing but rubber, vulcanized to the impeller and passages.

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LITERATURE . . .

Sodium Toluene Sulfonate Company makes available a Technical Bulletin with detailed information covering their line of sodium toluene sulfonate and potassium toluene sulfonate. Includes uses and specifications.
436A Hydrocarbon Chem.

Sprays, Live Stock LSO-30 is a dual-purpose oil spray formulation that contains Crag Fly Repellent. As a space spray it provides fast knock-down & high kill of flies in the barn. Information in Ref. No. F-3953-A.
436B Carbide & Carbon Chem.

Stabilizers Stabelan 110 is a liquid stabilizer for polyvinyl chloride resins & copolymers. Reference sheet contains: chemical composition; specification; recommended uses; etc. Request Bulletin No. 15-29-0-12-55.
436C Harwick Standard Chem. Co.

Sulphur Dioxide A versatile chemical reagent for industry, sulphur dioxide can be used as a reducing or bleaching agent, preservative, antichlor, neutralizer, pH control. Details in "Virginia SO₂" Folder.
42 *Virginia Smelting Co.

Tetrahydrofuran Finds increasing use in applying top coats of high molecular weight polyvinyl chloride molecular weight polyvinyl chlorides polyvinyl chloride sheeting and supported fabric. For complete information, request Technical Bulletin.
340-1e E. I. du Pont de Nemours.

Toluene Diisocyanate Isomeric Mixture Offers technical information on Nacconate 80. Describes: composition; typical analysis; chemical properties and suggested uses; physiological properties; etc. Tech. Bulletin ical properties; etc. Bul. 1-17A.
436D National Aniline Div.

Construction Materials

Alloys Speed up pickling & reduce maintenance with Hastelloy Alloys: higher bath temperatures; increased acid activity; decreased maintenance; less contamination. For complete information, request Ref. No. F-8943.
436E Haynes Stellite Co.

Alloys, Exhaust-Valve Engineering Bulletin features technical data on the corrosion characteristics; metallurgical consideration; & chemical physical & mechanical properties of exhaust-valve alloys. Vol. 1 No. 1.
436F Thompson Products.

Aluminum Resists weathering. Request reprints "Resistance of Aluminum Alloys to Weathering, and "Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres" for more complete information.
37 *Aluminum Co. of America.

Aluminum, Brazing "Brazing Alcoa Aluminum," a new product reference, presents practical shop data & up-to-date developments in the art of brazing aluminum. Descriptions of Alcoa brazing materials are treated in full.
436G Aluminum Co. of America.

Castings, High Alloy Covers facilities for producing high alloy static & centrifugal castings & offers data on castings used for resisting high temperatures, corrosion & abrasion. New General Catalog.
458 *Duraloy Co.

Coatings, Protective Describes Amercoat No. 87—a heavy bodied, high solids vinyl resin coating which can be applied at thicknesses up to 10 mils in one coat. General, physical & chemical properties detailed.
233 *Amercoat Corp.

Corrosion-Proofing Materials Brochure on corrosion-proofing materials & techniques contains information on cement mortars, interliners for masonry construction & protective linings for surface treatment. 8 p.
436H Pennsylvania Salt Mfg. Co.

*From advertisement, this issue

Electrodes, Welding..... "The Repair of Cast Iron Parts" outlines the latest data on the welding of cast iron with Ni-Rod & Ni-Rod "55." Nine graphic case histories show welding electrodes in action. Write directly to company.
437A International Nickel Co.

Fabricated Products, Polyethylene & Polyvinyl Chloride..... 48 p. reference illustrates & describes line of polyethylene & polyvinyl chloride fabricated products, plates, sheets, rods, tubes, etc. Bulletin AA-3.
R343 *American Agile Corp.

Fabrication, Stainless Steel..... Offers quality workmanship, economical fabrication to the most exacting specifications . . . in large or small quantities. "Sheet and Plate Fabrication" & "Electrical Enclosures" on request.
449 *Kirk & Blum Mfg. Co.

Fabrication, Steel & Alloy Plate..... New 48 p. reference describes in words & pictures the facilities & workscope of company—offering techniques in custom fabrication of steel & alloy plate. Catalog 554.
437B Nooter Corp.

Finishes, Industrial Maintenance..... 48 p. offers data on interior & exterior paint for walls, roofs, floors, etc. to serve as a guide in selecting Steelcote products suited to each maintenance need. Catalog 56.
437C Steelcote Mfg. Co.

Insulation, Block..... Eagle-Picher PV Supertemp block insulation . . . with the new "precision-finish." A highly efficient, all-purpose insulating block that is practically dustless. Offers valuable product sample.
46 *Eagle-Picher Co.

Insulation, Glass Fiber..... Versatile and efficient Ultralite features numerous advantages as insulation for all types of large heated equipment. Request "How-To-Do-It" details and specifications.
95 *Gustin-Bacon Mfg. Co.

Insulation, Pipe & Block..... 12 p. gives full data on hydrous calcium silicate insulation for hot outdoor piping & process equipment operating at service temperatures up to 1200 F. Tells how Thermobestos is made.
437D Johns-Manville.

Jacketing, Aluminum..... Features: Lap-Seal insures weather-seal; heavy weight jacketing takes abuse; & new resin adhesive that makes a stronger bond between the jacketing & vapor barrier. Data & samples.
252 *Childers Mfg. Co.

Laminate, Polyvinyl Chloride, Flexible-Rigid..... Entirely new Fligid was developed by Kaykor to specifically answer certain problems restricting the use of unplasticized Polyvinyl Chloride. Engrg. Bulletin FL-85.
437E Kaykor Industries.

Lining Material, Polyvinyl Chloride..... Unlike unplasticized Polyvinyl Chloride, which is a rigid material, Vyflex L-10 is highly flexible & lends itself to lining of process & other equipment easily. Engrg. Bul. L-10.
437F Kaykor Industries.

Plastics..... Vyflex F-92 is a light, but strong, corrosion-resistant plastic that has found wide application wherever corrosion is a threat to efficient operations. Complete technical information in Engrg. Bulletin F-92.
437G Kaykor Industries.

Refractories..... Carborundum has pioneered scores of super refractories with a wide variety of properties to meet your most demanding requirements. For complete details, request Refractories Booklet.
373 *Carborundum Co.

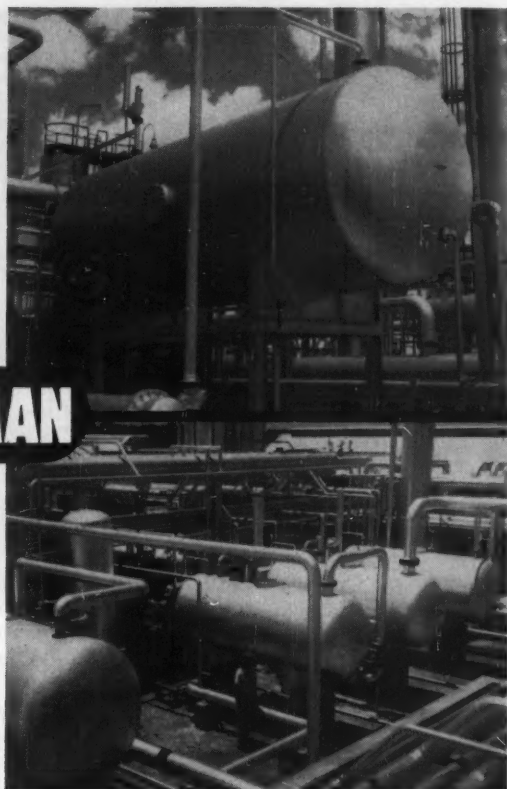
Rubber & Plastic Materials..... Piping, pumps, valves and tanks have a wide range of temperatures, pressure, impact resistance. For details about Ace rubber and plastic materials, request Technical Data CE-50.
326-7f *American Hard Rubber Co.

*From advertisement, this issue

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on Natural
Gas in

BOARDMAN

Pressure
Vessels!



In its plans for this Texas natural gasoline plant of the United Gas Pipe Line Company, Fish Engineering Company included rigid specification feed tanks and flash tanks. Boardman was chosen for the job because of its long experience manufacturing dependable pressure vessels. Fish Engineering knows that BOARDMAN welding procedures, fabricating and testing methods fully comply with API-ASME Code requirements, and readily pass all inspections by customer and insuring agency.

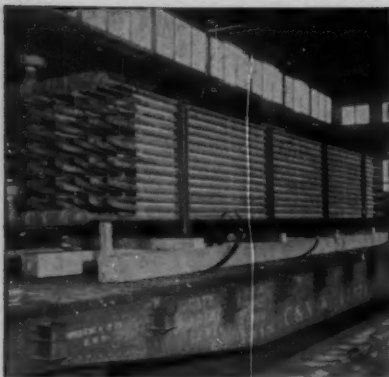
Pressure vessels represent only one of a thousand custom and standard metal products BOARDMAN designs, engineers and fabricates—many of them specifically for the chemical process industries . . . all with exacting standards of quality. BOARDMAN would like to discuss your metalcrafting needs.

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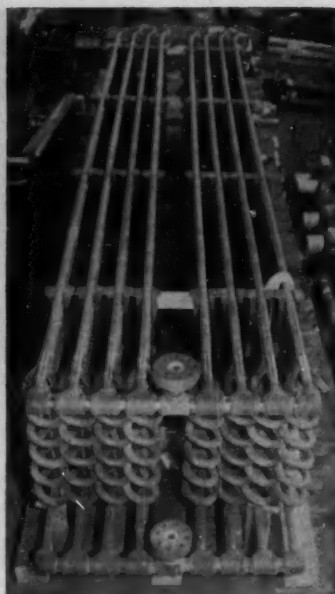
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BRANCH OFFICE: TULSA, OKLAHOMA



In the manufacture of ammonia, nitrogen and hydrogen are combined under heat and pressure with a catalyst and the resultant ammonia gas is then cooled in this Vilter ammonia synthesis cooler.

This Vilter unit was designed to operate at a working pressure of 10,000 lbs. psi. Bend in the tubing is off the vertical plane to permit easy flow of the gas in the cooler.



Q. Why do ammonia manufacturers use Vilter synthesis condensers?

A. because *Vilter* special heat exchangers cost less to own*

Not only cooling, but cooling under intense pressure, are the challenging aspects of designing and fabricating synthesis condensers used in the manufacture of ammonia. A tough job, yes... but at Vilter this problem is successfully resolved through the experience of having designed and produced thousands of heat exchangers and pressure vessels to exacting specifications for almost every type of application... working pressures as high as 10,000 psi. Of course, pressure vessels are built in conformance to A.S.M.E. and A.P.I. standards.

During the past few years, Vilter has supplied vessels to such nationally known companies as Shell Chemical, Esso Standard, Monsanto, Phillips Petroleum, American Cyanamid, Continental Oil among many others. These companies have learned that Vilter can give them what they want at the right price.

Vilter makes all four basic types of heat exchangers: shell and coil, shell and tube, shell and tube bundle, and atmospheric... and in every possible modification. Vilter can give you the most efficient heat exchange equipment required for a specific purpose. Consult with Vilter, today.

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LITERATURE . . .

Rubber Products, Silicone......Describes line of Silicone Rubber Products. Applications covered include molded & extruded parts for appliance, automotive & aircraft products as well as industrial seals. Bulletin AD147. 438A Garlock Packing Co.

Rubber, Synthetic......How to obtain rubber products with greater resistance to deterioration described in booklet. Tells how Hypalon chemical rubber solved problems in product design & plant maintenance. 8 p. 438B E. I. du Pont de Nemours.

Steels, Alloy & Stainless......Illustrated, 102 p. Includes corrosion resistant data, chemical composition, representative mechanical properties of corrosion-heat-impact-abrasion resistant alloy steels. Catalog No. 175-A. 438C Electric Steel Foundry Co.

Steels, Stainless......Covers superior stainless steel sheets, strip, bars plates, wire, forgings, etc. Data in informative 44 p. booklet, "Making the Most of Stainless Steels in the Chemical Processing Industry." 249 *Crucible Steel Co. of America.

Surfacing, Floor......Newest advancement in continuous search for better corrosion-proof materials—offers greater protection than conventional acid-proof floor materials. Trial sample of Corocrete on request. 427 *Celcote Co.

Titanium......Shows resistance to chloride solutions and retains useful strength up to 800-1000°F. Other advantages and data on application and fabrication of titanium alloys in descriptive Rem-Cru Review. 88 *Rem-Cru Titanium.

Electrical & Mechanical

Batteries, Flat-Plate......New folder describes and illustrates line of Exide Powerclad Flat-Plate Batteries. Feature: high power; electrical efficiency and dependability; low operating costs; etc. Form No. 5785-1-56-AO. 438D Electric Storage Battery Co.

Belts, V......Four reels of Velos adjustable v-belt replace up to 316 different sizes of endless belts—& take up a space of only 16 in. square. Velos Data Book contains valuable engineering data. 360 .. *Manheim Mfg. & Belting Co.

Drives......The Reeves automatic motor-drive is the economical answer to any continuous process requiring accurate control of heat, pressure, weight & flow, etc. Complete information in Bulletin CE20-M542. 316 *Reeves Pulley Co.

Drives, V-Belt......Fully illustrated, 36 p. booklet, entitled "Modern Multiple V-Belt Drives," discusses the origin, history and development of the modern multiple V-belt drive. Request your copy of Bulletin No. 20E8297. 438E Allis-Chalmers Mfg. Co.

Electrical Equipment......Installs easily, works correctly, and stays on the job for years without attention. More than 15,000 items are listed in the Conduit Catalog—fittings, plugs, etc. Request your copy. *Crouse-Hinds Co. 251

Expanders, Tube......Advantages: uniform & tight pressure joints; no over-rolled or under-rolled tubes; extended tube expander life; more production & higher profits. For more information, request Bulletin 55. 300 *Thomas C. Wilson

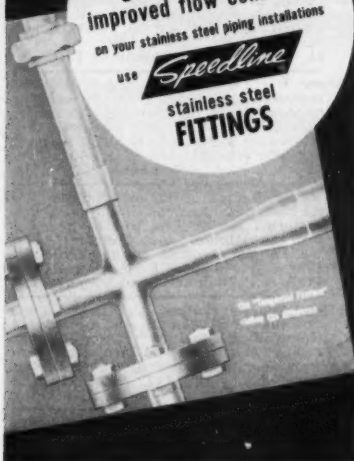
Gaskets......Do not show any signs of creeping or distress at 1650 psi steam pressure—850° F. Gaskets come in all sizes and shapes. Details on asbestos sheet packing and gaskets, in Bulletin CE46. 324 *Durabla Mfg. Co.

*From advertisement, this issue

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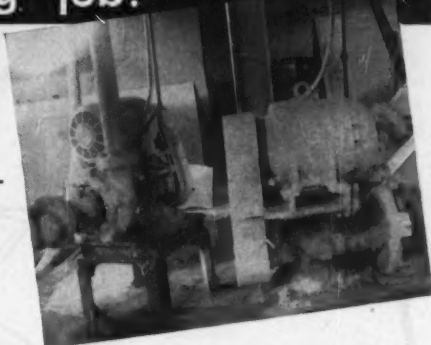
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Since 1946 Nagle 4" type "T", frame 119 L horizontal shaft, centrifugal pumps have yielded high performance handling a highly abrasive and heavy mixture of asbestos and portland cement, at a plant of Flintkote Co.—just the kind of gruelling application for which NAGLE PUMPS are designed. Water-end parts are abrasion resistant, highly effective stuffing box is readily accessible and slippage seal easily adjusted. Split bearing stand can be quickly dismantled, but that's seldom necessary.



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CONTROL OF COMPLEX CHEMICAL CONTAMINANTS made simple with MULTI-WASH COLLECTORS

Dust

Dust particles are removed from the air stream by impingement against wetted surfaces and through water curtain action. The constant change in direction of the air stream and its effect in creating turbulent action in the liquid serves to keep the inside collector surfaces clean. Effectiveness on both soluble and insoluble dusts is about the same.

Fumes

Fumes are also removed by impingement against the closely spaced turbine-like stationary vanes and flushed surfaces of the shell, deflectors and shelf plates. High collecting efficiency is obtainable even on sub-micron material.

Condensable Vapors

Through contact with the cooler liquid and wetted surfaces, many materials which are gaseous at high inlet temperatures are condensed into liquid droplets. These droplets are then collected by impingement, as in the case of dusts, and thus removed from the air stream.

Soluble Gases

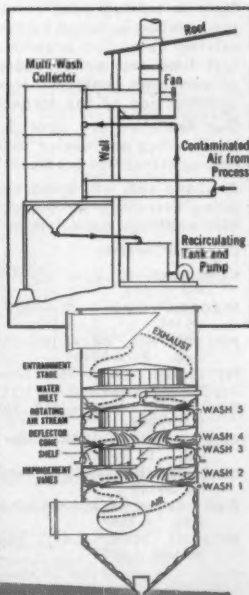
The intensive action of the air stream with the water curtains and spray patterns makes the Multi-Wash Collector very effective in the removal of soluble gases.

Acid Gases and Odors

Many successful installations are in operation where the gaseous contaminant in the air stream is removed through chemical reaction with the recirculated liquid. For example, hydrogen sulphide, sulphur dioxide, hydrochloric or hydrofluoric acid vapors will react readily with an alkaline solution. Some more complex odors can be removed or stabilized by means of an oxidizing chemical in the recirculated liquid.

Corrosion-resistant Construction

Standard Multi-Wash Collectors are constructed of heavy plain carbon steel. Special units are constructed of various types of stainless steel, Monel, Inconel, Hastelloy, Haves, copper or steel with special coatings to protect interior surfaces against corrosive action and assure long, efficient operation.



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LITERATURE . . .

Gaskets, Teflon. . . . The ideal seal for many process applications is a Flexitallic gasket with teflon trapped between edges of stainless steel. For complete data request folder, "Teflon in Flexitallic Gaskets."
312 *Flexitallic Gasket Co.

Motor Starter-Circuit Breakers. . . . Design, construction & performance of circuit breaker & motor starter. Unlets give maximum safety & unparalleled ease of wiring, installation, maintenance. Bulletin BH.
91 *Appleton Elec. Co.

Motors. . . . Describes newly designed standard & explosion-proof enclosed motors, featuring corrosion-resistant cast iron frames, improved winding insulation & heavy duty ball bearings. Bulletin No. MU-203 & MU-132.
72 *Wagner Elec. Corp.

Motors, Gear. . . . "Reduce Speed" describes new line of Reliance Gearmotors . . . the first line of gearmotors available incorporating new NEMA motors and completely redesigned gearheads. Bulletin E-2408.
440A Reliance Elec. & Engrg. Co.

Motors & Generators. . . . Information on the G-E Kinamatic Motors & Generators includes: application; ratings & frames; performance; construction; features; dimensions; etc. Spec. Sheets GEC-1372 & GEC-1373.
440B General Elec. Co.

Packings. . . . Belmont "centrifugal" type 754-P is a "custom-made" packing for centrifugal and rotary pumps that protects pump shafts against scoring, wear. Request Catalog on "custom-made" packings.
352a *U. S. Gasket Co.

Packings, Pump. . . . Chemiseal centrifugal pump packing . . . for all-chemical service is made in two types—pure duPont teflon and teflon with graphite. For complete details, request Catalog TP-1255.
352b *U. S. Gasket Co.

Packings, Teflon. . . . Chemlon Yarn Style C-30 extra tough packing provides valuable advantages. It can be used to handle the most destructive acids, alkalis or solvents. For details, request Bulletin No. P-321.
344 *Crane Packing Co.

Reducers, Speed. . . . Company offers a catalog on its line of worm gear reducers . . . for horizontal or vertical mounting; with worm above or below worm gear; etc. Request Catalog WG-51.
32 *Philadelphia Gear Wks.

Seals, Mechanical. . . . For meeting severe sealing conditions. Pressure from 50 psi to 1000 psi. Temperatures from minus 80°F. to 450°F. For data on applications, request Dura Seal Catalog 455-CE.
TL345 *Durametallic Corp.

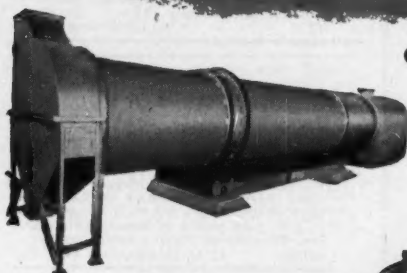
Seals, Mechanical, Rotary. . . . Company announces the availability of a new 8 p. reference which shows how you get maintenance-free sealing that slashes fluid mixing cost to a new low. Illustrated Bulletin B-111.
203h *Mixing Equipment Co.

Seals, Shaft. . . . Sealol's wealth of design & manufacturing experience assures users of chemical agitators & mixers of the best in seals. Complete engineering information and recommendations upon request.
R441 *Sealol Corp.

Starters. . . . A-B's line of motor starters have a variety of standard enclosures that satisfy any operating requirement. Only one moving part . . . the solenoid plunger. Request the A-B Handy Catalog.
274 *Allen-Bradley Co.

Teflon Products. . . . Illustrates various of the many special molded & machined parts firm has fabricated from pure teflon, glass-filled teflon, glass & carbon-filled teflon & zircon-filled teflon. Bulletin No. CP554.
426a *Chemical & Power Products.

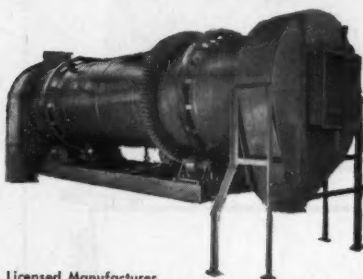
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DRYERS**AMMONIATORS*****GRANULATORS*****ELEVATORS****COOLERS****CONVEYORS***for the
Chemical
Industry***ROTARY COOLER**

Highly efficient shelf design for quick thermal release, with special feed and discharge breechings. Rotary seals prevent air losses.

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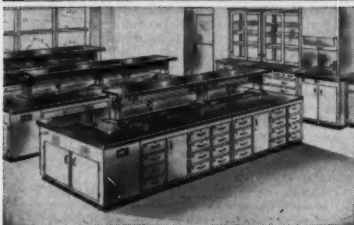
Heavy-Duty rotary unit with furnace, burner, breeching and air handling system. Used for ammoniated granular fertilizers and other chemicals. Also DehydrO-Mat Variable Inclination Dryers (Pat. pend.).



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See our pages in the **CHEMICAL CATALOG**, or ask for our Technical Data Bulletin No. 355—52 pages. Bulletin 256—price data—enables you to do your own estimating. Which do you want? 355? 256? Both?

Backed by 20 years in manufacturing of panel coils.

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DO IT YOURSELF !!**MAKE YOUR OWN PUMP
SEAL SELECTIONS!!**

THE NEW SEALOL FLEXIBOX SEAL-ECTOR ENABLES YOU TO DECIDE ON SEAL TYPE SIZE AND MATERIALS FOR YOUR SPECIFIC REQUIREMENTS. THE SEALECTOR COVERS 48 TYPICAL PRODUCTS BEING HANDLED IN THE PROCESS INDUSTRIES.

HERE'S HOW IT WORKS—

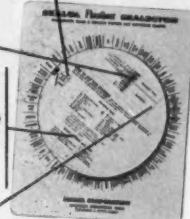
Typical Example — Butane @ 250 PSIG, 160°F
— Shaft Size 1½"

1.

**FRONT
PROCEDURE — STEP I —
AUTOMATIC SELECTION
OF SEAL TYPE AND MA-
TERIAL — SET POINTER ON
PRODUCT:**

TYPE —

RRCB FLEXIBOX

RR = BALANCED
DESIGNC = CIRCULATED
PRODUCTB = THROTTLE
BUSHING**MATERIAL —**

STATIONARY SEAL RING — CARBON

ROTARY SEAL RING — TYPE 347 STAINLESS
STEEL

ROTARY SEAL RING FACE — STELLITE

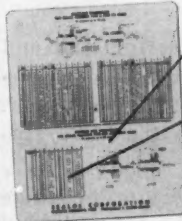
SPRING — TYPE 18-8 STAINLESS STEEL

GLAND PLATE — STEEL, PLATED

O RINGS — BUNA BASE RUBBER

2.

**BACK
STEP II — DETERMINE SEAL
SIZE FROM SHAFT DIMEN-
SION:**



TYPE = RRCB
SHAFT = 1.625"
MIN. STUFFING BOX
BORE = 2.625"
MIN. BOX DEPTH
= 2.625"
SEAL SIZE = 40

**SEND FOR YOUR SEALOL FLEXIBOX
SEALECTOR ON YOUR LETTERHEAD
TODAY — AT NO CHARGE.**

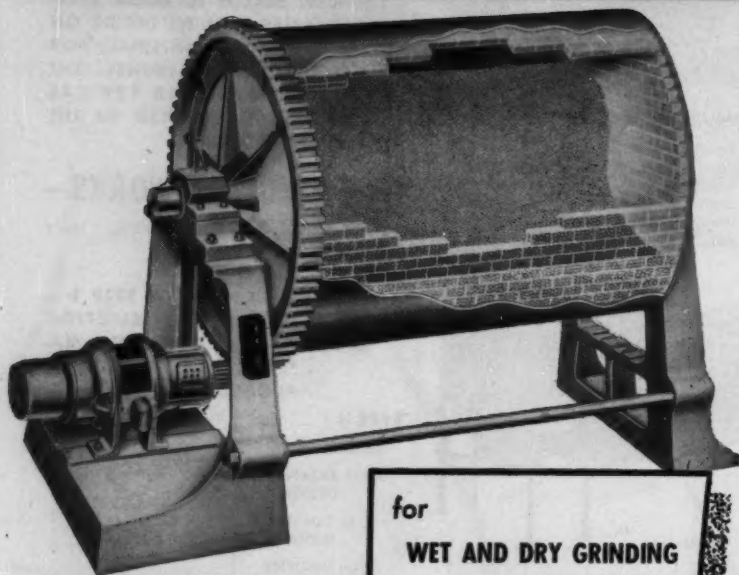
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ABBÉ Engineering Ball and Pebble Mills are available in capacities from 30 lbs. (dry), 5 gal. (wet), to 14,000 lbs. (dry), 2500 gal. (wet).

It will pay you to investigate these, as well as Abbé Jar Mills and Jar Rolling Machines, which cover every need and capacity.

Write for Catalogs 73 and 77 and complete data.



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50 Church Street, New York 7, N.Y.

LITERATURE . . .

Transformers, Arc Furnace. . . . Features: tap changers, core-type construction with inherently strong circular-concentric windings, dust-tight bus-bar seal, etc. For details, request Bulletin GEA-6236.
53 *General Electric Co.

Turbines, Steam. . . . Turbines range from 150 horsepower down to fractional in 6 frame sizes. Feature large number of manually operated valves for individual control of steam nozzles. Details in Bulletin 135.
77 *Coppus Engrg. Corp.

Handling & Packaging

Bag Packers. . . . An Auger-Matic Bag Packer offers you a simple and efficient method of filling paper valve bags at low costs. Sturdily constructed to give you years of dependable service. Illustrated Folder upon request.
442A E. D. Coddington Mfg. Co.

Belting, Conveyor. . . . Fully illustrated, 36 p. bulletin includes sections on: conveyor belting; coal conveyor belting; food processing belting; rubber accessories; engineering data. Request your copy of Bulletin No. 141.
442B Hewitt-Robins.

Clamps, Rotating Roll. . . . Lewis-Shepard announces a new 360° Rotating Roll Clamp which handles rolls from 24" to 48" in diameter in either the vertical or horizontal position. Makes available information.
442C Lewis-Shepard Products.

Conveyors. . . . The 375 transfer conveyor features: lengths from 8'; widths 18", 24" & 30"; & handles almost any bulk material. Company offers new Folder, showing how you can figure hp & belt width.
B1439 *Barber-Greene.

Conveyors, Sectional Belt. . . . Fully illustrated, 2 p. product reference describes Pre-Built sectional belt conveyors in standardized, pre-engineered units with capacities ranging up to 1500 tons per hr. Book 3579.
442D Link-Belt Co.

Conveyors, Steel, Galvanized. . . . Describes new Rapistan galvanized steel conveyors. Includes construction details & data on why galvanized steel gravity conveyors are best for use under all conditions. Form GAL-55.
442E Rapids-Standard Co.

Drums. . . . Tight head or removable head types . . . protect sensitive chemicals, oils, and food products against contamination during shipment or in storage. Request Hackney Drum and Barrel Catalog.
15 *Pressed Steel Tank Co.

Feeders, Rotary Airlock. . . . Illustrated, 12 p. bulletin covers the complete line of Frater Rotary Airlock Feeders. Includes data on selection, features, specifications, dimensions, installation, etc. Bulletin No. P-55.
442F Prater Pulverizer Co.

Magnets. . . . Covers newly designed line of non-electric Alnico Perma-Plate Magnets which incorporate an entirely new concept of tramp iron removal by the "Dynamic" principle of magnetic attraction. Catalog 1205-D.
442G Dings Magnetic Separator Co.

Magnets, Permanent. . . . Engineers who design & develop products utilizing permanent magnets will find "Permanent Magnet Materials & Their Selection," a practical & convenient reference. Request Manual No. 5-R.
442H Indiana Steel Products Co.

Packaging, Collapsible Tube. . . . Illustrated, 16 p. brochure, "Tube Talk," includes sections on: what are collapsible tubes; tube terms; choosing the right tube; selecting the metal; standard tube sizes and necks; etc.
442I National Collapsible Tube.

*From advertisement, this issue

Packaging, Corrugated......"How To Ship More Economically in Corrugated Boxes" describes design of a corrugated box, testing, storage, shipping room layout, packing, sealing, stacking and loading. Illustrated, 24 p. 443A Hinde & Dauch.

Proportioning, Automatic......Furnishes information on Richardson's automatic proportioning systems. Includes complete case history file of Select-O-Weigh installation in industry. 28 p. Bulletin 0351. *Richardson Scale Co. 74

Scales, Truck......Available with Toledo Printweigh for recording weights on tickets, strips or sheets. Four-section scales are built to weigh the heaviest & largest highway vehicles. Bulletin 2417. 318 *Toledo Scale Co.

Sodium Handling, Metallic......Illustrated. 44 p. brochure, "Handling Metallic Sodium On A Plant Scale," contains data such as details of typical sodium-using processes; details of equipment installation, insulation. 443B U. S. Industrial Chem. Co.

Trucks, Fork Lift......Profusely illustrated Folder describes Lamson Mobilift "Sit-down" Fork Trucks with Hydra-Lizer hydraulic suspension system and Mobil-Matic automatic drive. Features and advantages. 443C Lamson Mobilift Corp.

Trucks, Industrial......Offers the most complete line of industrial trucks... The Master Line. Illustrated booklet covers electric fork trucks, electric tiering trucks, stackers, cranes, etc. Circular 80-203. 443D Lewis-Shepard Products.

Vibratory Equipment......Electro-permanent magnetic Hi-Fi vibratory equipment needs no rectifier. Operates at 3600 CPM directly off an AC line. Units are automatically self-adjusted. Request data. 97 *Eriez Mfg. Co.

Heating & Cooling

Boilers, Packaged......Describes the new forced-draft "CB—with the fan mounted inside the front hinged door." Latest Boiler Bulletin covers your size requirements—contains specification data to help you plan. 39 *Cleaver-Brooks Co.

Burners, High Velocity......Completely separate from the liquid being heated & maintenance, control & accessibility are greatly simplified. High heat release rate in these submerged combustion units. Bul. 110. R455 *Thermal Research & Engrs.

Condensers, Barometric......For removing air, exhaust steam, & other vapors from vacuum equipment. Includes: condenser theory; basic condenser types; features; application & construction data; etc. Bulletin 5AA. 443E Schutte & Koerting Co.

Coolers, After......Illustrated, 8 p. explains the functions of the Niagara Aero After Cooler in removing moisture from compressed air and gas. Details the outstanding features and advantages. Bulletin No. 130. 443F Niagara Blower Co.

Coolers, Cascade......Designed for cooling corrosive liquids and gases. Low initial cost and maintenance, radiused returns for low pressure drop as well as redwood waterguide strips. Catalog Section No. S-6820. 225e *National Carbon Co.

Generators, Steam......Water, force-circulated through a Modulatic steam generator, absorbs heat more thoroughly. Vapor's water-tube design provides unique spaced heat-transfer surfaces. Bulletin 586. 271 *Vapor Heating Corp.

*From advertisement, this issue



Lawrence Vertical
Top-Suction Liquid
Oxygen Pump

PUMPS to handle LIQUID OXYGEN

At -297.4°F. — the boiling point of liquid oxygen — many abnormal factors must be considered in designing a centrifugal pump. Metals become brittle... packing will freeze solid... the net positive suction head is usually very low, so that the liquid is at or near its boiling point. All of these difficulties are successfully overcome in Lawrence Vertical Top-Suction liquid oxygen pumps.

Lawrence construction employs metals not affected by the extreme low temperature and locates the packing far enough above the liquid so that it is exposed only to the oxygen vapors and functions normally. Location of the suction on top prevents vapor binding, even at boiling point.

If your problem involves pumping a liquefied gas at extreme low temperature, write us the pertinent details. No obligation.

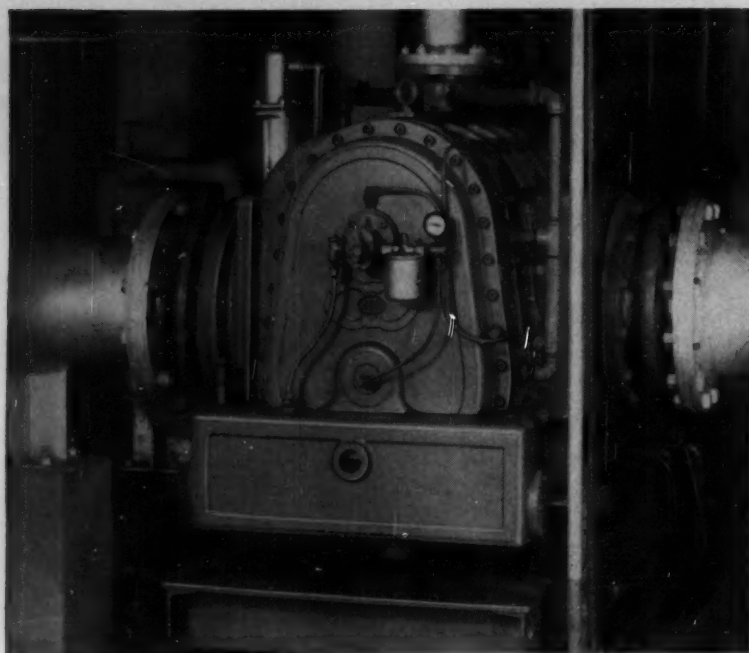


Write for Bulletin 203-7 for summary
of acid and chemical pump data.



LAWRENCE PUMPS INC.

371 MARKET STREET, LAWRENCE, MASS.



4 years of gruelling operation frequently at overload pressures and still no maintenance needed

Since 1951, Standardaire Blowers installed at Spencer Chemical Company have been operating 24 hours a day supplying process air for production of synthetic ammonia.

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Exclusive cycloidal design and simple, compact construction enable Standardaire Blowers to move more gas or air per pound of blower, with less wear, less maintenance and power consumption. Write for complete information.

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LITERATURE . . .

Heat Exchange Equipment. . . . Frick's engineering staff is well equipped to meet your heat transfer, refrigeration and air conditioning problems. For more complete information on their line, request details.
430 *Frick Co.

Heat Exchangers. . . . Description of Chromalox electric circulation heaters and methods of applying for controlled heating of water, oils, heat transfer media, steam and air and other gases. Product Bulletin 701.
444A Edwin L. Wiegand Co.

Heat Exchangers. . . . Describes how equipment offers: chemical resistance to practically all corrosive fluids; resistance to severe thermal shock; high heat-transfer rates; low maintenance; etc. Catalog S-6740.
225e *National Carbon Co.

Heat Exchangers. . . . Covers complete line of Karbate brand impervious graphite shell & tube heat exchangers. Engineered for maximum corrosion resistance & minimum maintenance. Catalog Section No. S-6800.
325d *National Carbon Co.

Heat Exchangers. . . . New, illustrated 12 p. Catalog describes impervite "Cross-Bore" and "Cubical" corrosion-proof heat exchangers, includes features, scale drawings, dimensions for all models, etc. Bulletin No. 537.
444B Falls Industries.

Heat Exchangers. . . . Describes an improved design heat exchanger . . . the Type "BD." Includes data on features, construction, materials of construction, sizes available, dimensions, etc. Bulletin Supplement 12-HS.
444C Schutte & Koretting Co.

Heat Exchangers. . . . Illustrated, 16 p. provides data on use of aluminum in heat exchangers. Includes: advantages; application information; design data; fabrication considerations; engineering service.
444D Reynolds Metals Co.

Heat Transfer Apparatus. . . . Illustrated, 24 p. catalog describes National Sections of various types that are used to build cooling and condensing systems for process fluids. Details features, uses, etc. Catalog No. HT-23.
444E National-U.S. Radiator Corp.

Heaters, Gradation. . . . Makes available detailed literature—"Try the Gradation Heater for Economical Ethylene Production" and bulletin, "Gradation Heating for Petroleum and Chemical Processing."
20 *Selas Corp. of America.

Heaters, Radiant. . . . Illustrates the "10 Big Advantages of Far-Infrared." Contains full catalog data—sizes available & prices, also lists input controllers for infinite control of intensity. Product Bulletin CS-604.
444F Edwin L. Wiegand Co.

Heaters, Steam Water. . . . Thoroughly illustrated 12 p. brochures the Johnson line of "Instant" steam water heaters . . . for instantaneous booster or storage heating of water. Request copy of Bulletin "H."
444G Johnson Corp.

Heating Units, Electric. . . . There is a Chromalox electric heating package especially for any job where heat is needed. 15,000 standard types, sizes & ratings are available. Request details.
71 *Edwin L. Wiegand Co.

Hot Oil Systems, Electrically Heated. . . . Merrill Process Systems produce any oil temperature within range of 150-600° F at low pressure in a compact, completely assembled packaged unit. See Bulletin 1255.
445A Parks-Cramer Co.

Panels, Radiant. . . . Radiant panels for faster web heating; extra wide radiant panels for web heating in paper, textile, plastics & other operations; catalog data, specifications, advantages. Product Bulletin CS-606.
445B Edwin L. Wiegand Co.

*From advertisement, this issue

Preheaters, Air.....The Ljungstrom boosts products quality & its heat-recovery efficiency makes possible advanced furnace designs that assure close control of processing. For information, request product data.
80 *Air Preheater Corp.

Refrigeration Equipment.....50 p. gives complete data on CenTraVac centrifugal refrigeration equipment, which is used to provide chilled water for air conditioning & refrigeration systems. Illustrated Bulletin DS-399.
445C Trane Co.

Traps, Steam.....The right steam trap for light condensate loads... Yarrow 20-A Impulse Steam Trap. Features small size, stainless steel body & working parts, low cost, etc. Bulletin T-1739-X.
365 *Yarnall-Waring Co.

Vaporizers.....Newest Union Packaged Vaporizer—Type MH—provides broad range of temperatures at low pressure for process heating. Details of this and other process heating equipment in Illustrated Bulletin DV.
445D Union Iron Wks.

Vaporizers, Dowtherm.....International-LaMont dowtherm vaporizers provide accurate temperatures from 500°-750°F for the process industries. Specific features of advanced design described in Bulletin.
445E International Boiler Wks. Co.

Instruments & Controls

Analyzers.....Develops a completely self-contained portable analyzer and alarm system for combustible gases. Designed for use in or near hazardous locations. Details the outstanding features in Illustrated Bulletin features in Bulletin 11-35.
445F Davis Instruments.

Automation....."Instrumentation" carries case history studies of how industry applies automation techniques in everything from atomic energy, research, utility plants, heat treating of metals to chocolate processing.
445G Minneapolis-Honeywell.

Controllability Analysis, pH.....Unique Analysis gives vital data about controllability factors of individual waste treatment processes. Outlines approach in company's Process Data Sheet No. 799(2).
96 *Leeds & Northrup Co.

Controllers, Temperature.....Completely revised product reference describes the Sarco line of Type LSI Electric Indicating Temperature Controllers. Includes a simplified operational sketch. Bulletin No. 1025B.
207 *Sarco Co.

Control, Process.....Feature the utmost in centralized recording & control efficiency. Require minimum of panel space, yet offer unsurpassed operator convenience, visual accuracy, etc. Bulletin 13-18.
44-5 *Foxboro Co.

Controls, Temperature.....Completely illustrated, 16 p. catalog presents company's line of standard local mounted temperature controls. Includes theory, features, general specifications, etc. Request Catalog Section No. 100.
445H United Elec. Controls Co.

Controls, Temperature.....Type D5 remote bulb temperature control is a precision unit containing a micrometer adjustment for obtaining wide ranges & accurate temperature settings. Request Catalog Section 200.
320 *Unitted Elec. Controls Co.

Fractometers, Vapor.....Model P-E 154 vapor fractometer gives you Butene separation in 15 minutes. Revolutionary advance in the field of gas & volatile-liquid analysis. Request descriptive Bulletin.
112 *Perkin-Elmer Corp.

*From advertisement, this issue



O-RINGS

are a valve's best friend

Let's face it... dripping, leaky valves are just not socially acceptable... so, we designed the new Hoke bar stock needle valve with an O-ring stem seal—to give it the right start in life. Result—a seal that will pass a helium leak test and no leaky, messy packing adjustments—ever. No friction either (even at high pressure)—you can operate the valve with a fingertip touch. There's a new, self-aligning spindle which shuts off tight time after time without galling or binding.

As you can see, the Hoke bar stock valve will contribute ease of operation, low maintenance cost and neat appearance to your equipment—hydraulic, pneumatic, instrument panel or test stand. It's available from stock in a wide range of sizes (1/8" to 1/2" pipe) and materials (carbon, chrome or stainless steel and brass)... panel mounting, too if you need it. We'd like to send you our Bulletin.

P.S. We've just published a new wall chart on Hoke valves with valuable information on valve sizing and corrosion resistance. May we send you one?



**HOKE
INCORPORATED**

Fluid Control Specialists
139 S. DEAN STREET, ENGLEWOOD, N. J.

TANTALUM...

there are many kinds
of "costs"
...but only one
true COST

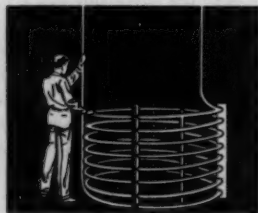
The cost of chemical processing equipment can be measured by the pound, by the square foot, by the unit, or by other yardsticks. Only one cost, however, is truly significant or all inclusive: the equipment cost per pound or ton of product per year.

Tantalum, being immune and not merely "resistant" to acid attack, is an attractive material of construction from an over-all cost standpoint. Properly used, it eliminates corrosion, product contamination, undesirable side reactions; it also decreases down time and maintenance costs. It has excellent heat transfer properties and is not damaged by thermal shock. It is light in weight, easily installed, requires no elaborate framework.

For low over-all costs in process equipment, look into Tantalum. The experience of Fansteel engineers will be a valuable supplement to your own technical staff.

USE TANTALUM WITH ECONOMY for most acid solutions and corrosive gases or vapors.

Not recommended for HF, strong alkalis or substances containing free SO₃.



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FANSTEEL METALLURGICAL CORPORATION

Chemical Equipment Division
NORTH CHICAGO, ILLINOIS, U.S.A.

G564A

LITERATURE . . .

Gages, Filter. . . . Describes Bacharach filter gages for commercial & industrial ventilating & cooling systems. Includes exclusive features, operating principle & design, typical specifications, etc. Illustrated Leaflet 854.
446A Bacharach Industrial Instr.

Indicators, Vertical Scale. . . . Describes the new Honeywell Tel-O-Set vertical scale indicators. Up-to-date information on the Tel-O-Set recorders & controllers is also included. Request 12 p. illustrated Bulletin 7202.
446B Minneapolis-Honeywell.

Inspection, Ultrasonic. . . . Describes the Sperry Ultrasonic Reflectoscope inspection instrument for the non-destructive detection of defects within materials. Details principle of ultrasonic inspection. Bulletin 50-105.
446C Sperry Products.

Instrumentation. . . . Company offers bulletin on its line of automatic controlling, recording and telemetering instruments. For more complete information, request a copy of 36 p. Bulletin P1245.
234-5 Bristol Co.

Instruments, Industrial. . . . Marsh offers endless types, ranges and case styles of instruments. For more complete information, request a copy of the new fact-filled catalog on pressure gages and dial thermometers.
TL359 Marsh Instrument Co.

Measurement, Temperature. . . . The Alnor Pyrocon combines laboratory precision with production tool ruggedness to give you fast, accurate answers to all surface temperature problems. Request Bulletin.
R345 Illinois Testing Labs.

Meters. . . . The Auto-Stop batching meter shuts off automatically . . . accurately . . . leaving the operator free to devote full attention to other details. Complete data contained in Bulletin No. 566S.
450 Neptune Meter Co.

Meters, Flow. . . . Feature simple design with only three moving parts—no breakdown due to complicated gears and mechanism. Indicate flow within 3% absolute accuracy, even with pulsating flow. Detailed Bulletin.
TL357 Henssey Co.

Meters, Millisecond. . . . Describes the Model 25E Chronotest Millisecond Meter . . . for measurement & direct indication of short time intervals in the milli-second region with high accuracy, convenience & versatility.
446D Herman H. Sticht Co.

Meters, Moisture. . . . Reference describes the new Rogers Moisture-Controller . . . the first continuous, automatic moisture meter which measures, indicates, records & controls. Covers operation & specifications.
446E Quaker Oats Co.

Radiation. . . . Illustrated, 34 p. book, "High Voltage Electron-Beam Processing," is an authoritative survey of radiation machines & their application in chemical processing, sterilization & research. Bulletin E.
446F High Voltage Engrg. Corp.

Recorders. . . . Offer valuable features: pre-calibrated plunger receiver units; up to 4 pneumatic or electronic receivers—or 2 receivers & 2 integrators; etc. Products Spec. E12-5 & actual chart sample on request.
301 Bailey Meter Co.

Rotameters. . . . New reference includes outline & cross-section drawings. Series 18200 Safeguard Rotameter constructions & includes front & rear panel mounting dimensions. Data & features in Bulletin 18-RG-A.
449A Schutte & Koerting Co.

Scanning & Logging Systems. . . . Fully illustrated, 14 p. brochure describes the Taylor "Trans Scan Log" control system. Permits quick identification, evaluation & correction of any process change. Bulletin 98268.
76 Taylor Instruments Cos.

INCREASE HEAT EXCHANGER CAPACITY WITHOUT REDESIGN



This is Wolverine Trufin* Type S/T—the integral finned condenser tube with the extended surface that means increased performance and economy.

You can increase heat exchanger capacity—without unit redesign—simply by retubing with Wolverine Trufin* Type S/T.

Trufin Type S/T is an extended surface tube that boosts performance—steps up BTU output per foot of tube. Type S/T's gain in heat duty comes directly from its integral fins which are extruded right from the tube wall. As a result of this, Type S/T provides a greater heat transfer surface than prime surface tube—substantially increases the capacity of existing units.

Wolverine Trufin Type S/T is interchangeable with prime surface tube—no unit redesign is necessary. The ends of the tube are plain and designed so that the O.D. of the plain end is slightly greater than the O.D. over the fins. This allows the tube to be inserted into bundles in the regular manner using standard tools and techniques. As a further refinement plain lands (unfinned sections) can be spaced along the length of tube at intervals corresponding to your baffle positions.

In addition to increased capacity plus saving in time, labor and material, Type S/T also provides more "on stream" time. Because its fins are part of the tube wall they never shake loose under vibration, high pressures or varying temperatures. Actual operating data proves that Type S/T resists fouling for longer periods than does prime surface tube. Efficiency goes up and stays up.

For complete case histories and pertinent information write for your copy of the Trufin Opportunity Book. You'll be glad you did.

WOLVERINE TUBE, 1443 Central Avenue, Detroit 9, Michigan.

*REGISTERED U.S. PATENT OFFICE

DIVISIONS OF
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WOLVERINE TUBE DIVISION
CANADA VULCANIZER
& EQUIPMENT CO., LTD.
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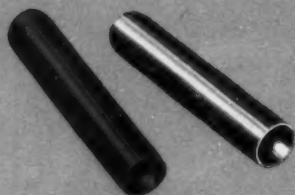
WOLVERINE TUBE

Division of Calumet & Hecla, Inc.

Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES
EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, NEW YORK

6 SURE ANSWERS TO YOUR CONDENSER TUBE NEEDS



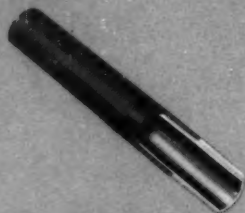
PRIME SURFACE TUBE

Wolverine manufactures prime surface tubing in copper, copper-base alloys and aluminum in a wide range of sizes.



DUPLEX PRIME SURFACE TUBE

Here's a tube designed to handle two types of corrosion simultaneously. It is composed of a tube of one metal and a liner of another. The combination can be any alloy you need to meet special conditions.



DUPLEX TYPE S/T

This tube also is designed for specific corrosive conditions. But, like Trufin, it has integral fins—will boost heat transfer efficiency. It can be used instead of prime surface tube.

Wolverine has worked so closely over the years with the processing industry and has accumulated a wealth of knowledge and experience related to condenser tube applications.

From this knowledge has come, in addition to Wolverine Trufin* Type S/T, a complete condenser tube line-up—encompassing six sure-fire answers to your heat transfer problems.

If your problem happens to be corrosion, Wolverine gives you a choice of many alloys—individually or in a combination. Supposing, for example, you're faced with a different corrosive attack on both shell and tube side. The right tube for you is Wolverine Duplex because it gives you an inner liner and outer tube of two different metals or alloys mechanically bonded together.

Wolverine also gives you a choice of either finned or prime surface tube in many sizes and alloys. Trufin alone, is made in five distinct types—each specifically designed to provide increased heat transfer and combat peculiar process problems.

Described elsewhere on this page is the complete Wolverine line-up. Study each carefully because one, or perhaps more, of them can be your answer to increased heat transfer efficiency and lower costs. The entire story is told in Wolverine's Condenser Tube Catalog. Write for your copy—TODAY!

WOLVERINE TUBE, 1443 Central Ave., Detroit 9, Mich.

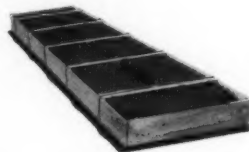
*REGISTERED U.S. PATENT OFFICE

Wolverine Trufin available in Canada through the Unifin Tube Company, London, Ontario.



TRUFIN TYPE L/C

Trufin, in high-finned aluminum tube, is mechanically bonded to an interior liner of the alloy which best beats your corrosion hazard. Type L/C is pretested to insure excellent heat transfer performance.



U-BEND PALLETS

This new Wolverine idea cuts time, reduces storage problems and saves money. U-bend condenser tubes—either finned or prime surface—are arranged in a disposable box-type pallet in the exact order you specify. All you have to do is feed them directly from pallet to unit.



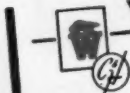
FIELD ENGINEERING SERVICE

This is a Wolverine "extra"—a staff of highly skilled tubing technicians. You can get experienced help in solving problems dealing with alloys, corrosion design or fabrication.

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Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA
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LITERATURE . . .

Spectrometers, Mass. Types 21-610 & 21-620 are exceptionally versatile, provide stream-composition information on the spot for regulating plant start-up procedures, etc. Flexible & simplified. Bul. CEC 1824B-X2. 367 *Consolidated Electrodynamics.

Telemetering, Logging & Reporting Systems. Covers telemetering, logging & reporting system adopted to metering of remote points & logging of telemetered data at a central control point. Bulletin No. 535. 449B Norwood Controls Unit.

Thermostats, Electric. Revised reference describes electric room thermostats for factories and institutions. Also features immersion thermostats for hot water heating systems, etc. Request Bulletin No. 1000B. 449C Sarco Co.

Wire, Thermocouple & Extension. Company offers 8 p. Wire Bulletin describing insulations, gages, & calibration symbols, color codes, insulation characteristics, resistances, weights, etc. Bulletin 31-E. 460 *Thermo Electric Co.

Pipe, Fittings, Valves

Fittings. Offers Klinger Master Catalog describing the complete range of products . . . compressed asbestos sheet packings for all purposes, valves, cocks, level gages, synthetic and silicone rubbers, etc. 133 *Klinger Corp. of America.

Fittings & Flanges, Polyvinyl Chloride Illustrated, 12 p. describes line of polyvinyl chloride pipe fittings & flanges. Includes: characteristics & advantages; corrosion-resistance; applications; fabrication; etc. 449D Grinnell Co.

Fittings, Stainless Steel. Speedline fittings simplify pipeline design. Details of the greater design flexibility possible with Speedline fittings . . . at lower cost . . . in new fully illustrated catalog. TL439 *Horace T. Potts Co.

Hose & Belting. Presents a profusely illustrated, 76 p. Catalog on hose, belting, packing, molded & lathe-cut goods & mats. Includes information on sizes, weights, applications, construction features, etc. 449E Hamilton Rubber Mfg. Corp.

Joints, Expansion. New, illustrated 24 p. Expansion Joint Design Guide contains engineering application & selection data that is necessary to the proper solution of pipeline expansion problems. Catalog No. 153. 449F Flexonics Corp.

Joints, Expansion. New reference on HydroLastic expansion joints gives details of construction & specifications along with directions for ordering & application data for various piping systems. 24 p. Catalog 53. 449G Cook Elec. Co.

Joints, Rotary Pressure. Used to admit steam or fluids under pressure into paper machines, textile machines & similar machines with rotating rolls & drums. Operation & features in Bulletins Nos. J-2001, S-2001. 449H Johnson Corp.

Joints, Swing. Covers information & detailed specifications on 35 styles of bronze & steel, plain & flanged swing joints. Recommendations & data on use, care & maintenance of equipment. 12 p. Catalog No. F-3. 298 *OPW Corp.

Nozzles. Describes company's line of nozzles for: oil atomizing; humidifying; air washing; desuperheating; spray ponds; milk powdering; acid chambers; concrete curing; etc. Request Catalogs 6-A and 6-C. R359 *Monarch Mfg. Wks.

*From advertisement, this issue

Pulp Tank
prepared for
Plastic Lining



KIRK & BLUM

offers
specialized experience in
**STAINLESS STEEL
FABRICATION**

Stainless fabrication is distinctively different from conventional steel working. The Kirk & Blum organization has the special knowledge and technique required . . . and the experience and necessary equipment for this highly specialized type of work. With 49 years of experience in sheet metal fabricating, Kirk and Blum offers quality workmanship, economical fabrication to the most exacting specifications . . . in large or small quantities.

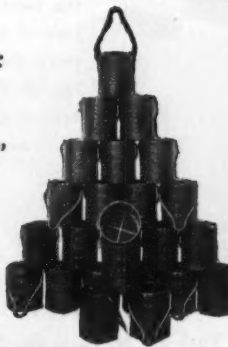
Complete facilities to 1/4" capacity for: square or rotary shearing; braking, forming, rolling; punching, riveting, drilling; arc, spot and seam welding; inert gas and submerged arc welding; grinding and finishing. For prompt quotation, send prints and details.

THE KIRK & BLUM MANUFACTURING CO.
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Literature on request:

"SHEET and PLATE
FABRICATION"

"ELECTRICAL ENCLOSURES"



KIRK & BLUM

METAL FABRICATION

We Bring Your Prints to Life

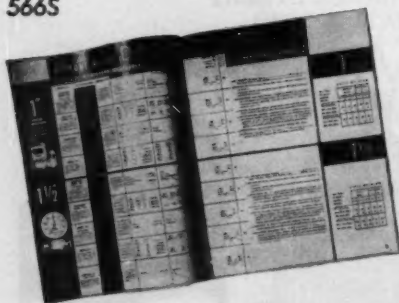
Three Neptune Meters Boost Production 200%



Less than half a minute of a man's time is required to measure three ingredients . . . corn syrup, liquid sugar, and water . . . into each batch of Nalley's table syrup. The operator simply pushes buttons on the Neptune Auto-Stop meters to set the pounds required by the formula, and opens the valves. The Auto-Stops shut off automatically . . . accurately . . . leaving the operator free to devote full attention to other details.

One man now produces more than three times as much as formerly was produced by five men handling bulk sugar and barreled corn syrup.

Ask for helpful
Meter Selection Book
566S



This Auto-Stop batching meter is only one of many models and sizes of Neptune meters . . . ranging from meters with simple counters to electric switch adaptations and remote control systems . . . now handling more than 150 different industrial liquids. Sizes from 25 to 1000 gpm. Bronze construction. Telephone or write nearest branch for full details.

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LITERATURE . . .

Nozzles, Spray Company provides a 48 p. industrial catalog with full data on thousands of standard and special nozzles—for every type of spraying. Also information on related equipment. Catalog No. 24.
TL353 *Spraying Systems Co.

Pipe & Fittings For corrosion-resistant piping. Impervious graphite pipe & fittings readily installed, long lasting, easily maintained, unaffected by most corrosive fluids. Catalog Section No. S-7000.
225b *National Carbon Co.

Pipe, Plastic General-purpose moderately priced rubber-plastic pipe handles most common chemicals to 170° F. . . except few strong acids & organic solvents. Tough, odorless, tasteless. Bulletin No. 80.
326-7e *American Hard Rubber Co.

Pipe, Plastic Ace Rivivlor is a new rigid threaded plastic pipe with good aging & high impact strength. Not affected by most inorganic acids & alkalis. Excellent for many organics. Request Bulletin CE-56.
326-7a *American Hard Rubber Co.

Pipe, Polyvinyl Chloride Describes Ryertex-Omicron PVC rigid type unplasticized pipe. Gives engineering data on pipe & lists over 200 chemicals it will convey without being attacked. Technical Bulletin No. 80-3.
450A Joseph T. Ryerson & Son.

Pipe, Saran Lined Saran lined pipe, fittings and valves cut corrosion costs . . . can be cut in the field with available pipe fitter's tools. Liquid never touches metal in saran lined pipe. Request details.
64 *Saran Lined Pipe Co.

Tubes, Heat Exchanger Contain the right amount of antimony needed to resist dezincification and other forms of corrosion. For more information, request Chase Condenser and Heat Exchanger Booklet.
40 *Chase Brass & Copper Co.

Tubes, Heat Exchanger Duplex tubes are supplied in more than 100 combinations of ferrous & nonferrous metals. Take advantage of the best qualities of both metals; best where dual corrosion exists. Bul. 1954.
368 *Bridgeport Brass Co.

Tubing, Flexible Hundreds of applications in the steam and Diesel power fields are filled by Penflex flexible tubing. For complete information on product line, request copy of "Flexi-neering" booklet.
50 *Pa. Flexible Metallic Tubing.

Tubing & Pipe, Stainless Folder offers data on welding characteristics of both austenitic & ferritic types of stainless steels & briefly covers various welding methods & techniques. Technical Data Card No. 162A.
450B Babcock & Wilcox Co.

Tubing, Plastic Excellent chemical-resistant, all-purpose flexible plastic tubing. Sparkling clear, easy to clean, odorless, non-toxic, can be steam-sterilized. For details request Bulletin No. 66.
326-7b *American Hard Rubber Co.

Unions, Forged Steel Describes line of new forged steel unions. Presents complete dimensions of unions in sizes 1" to 2" in 3000 lb. class. Also covers outstanding design features. Illustrated Bulletin U-1.
323 *Watson-Stillman Fittings.

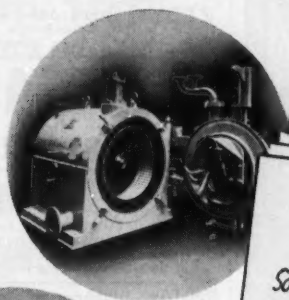
Valves Proper design and the correct choice of metals combine in the OIC forged steel line to assure adequate strength, safety, and long trouble-free operation on chlorine service. Request Bulletin No. 1000.
87a *Ohio Injector Co.

Valves Golden-Anderson designs and manufacturers valves that give dependable operation . . . that need little maintenance . . . that last a lifetime. Technical bulletins describing line are available.
BL345 *Golden-Anderson.

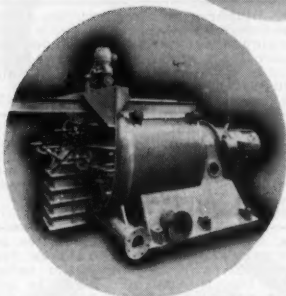
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Out of the Engineer's Workbook...

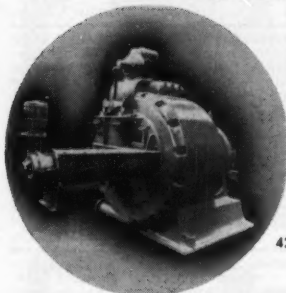
28" DIAMETER



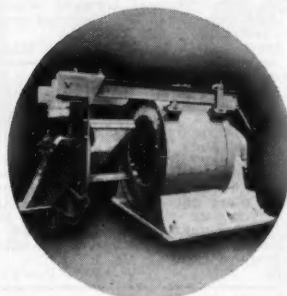
36" DIAMETER



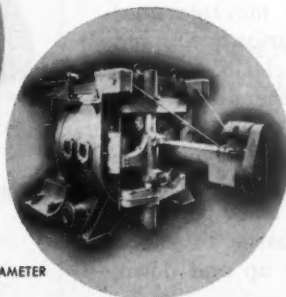
42" DIAMETER



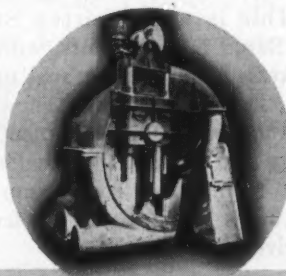
50" DIAMETER



67" DIAMETER



79" DIAMETER



REINEVELD CHEMICAL CENTRIFUGES

Solids Capacities of Machines on Typical Liquid-Solid Slurries-Lbs per hr.

PRODUCT	SIZES						SM%
	28	36	42	50	67	79	
Sodium Bicarbonate	1490	3240	4200	6430	11040	14650	7 1/2
Di Cal. Phosp.	341	744	962	1475	2530	3360	13-15
Glauber's Salt	2540	5540	7180	11000	18900	25000	2.3
Gypsum	930	2020	2620	4010	6900	9150	8-10
Corn Starch	806	1755	2280	3490	5980	7930	16
Para Xylene	1740	3775	4900	7500	12880	17080	8-18
Polystyrene	1925	4190	5420	8300	14280	18900	1-3
Sulfa Drug	93	202	262	401	690	915	19

This table is illustrative of capacities and surface moistures obtained from the Reineveld Centrifuge. It is only a fragment of the complete information for your dewatering problems . . . now available from Heyl & Patterson engineers.

Phone or write for a copy of the
new Reineveld Brochure RC-356.

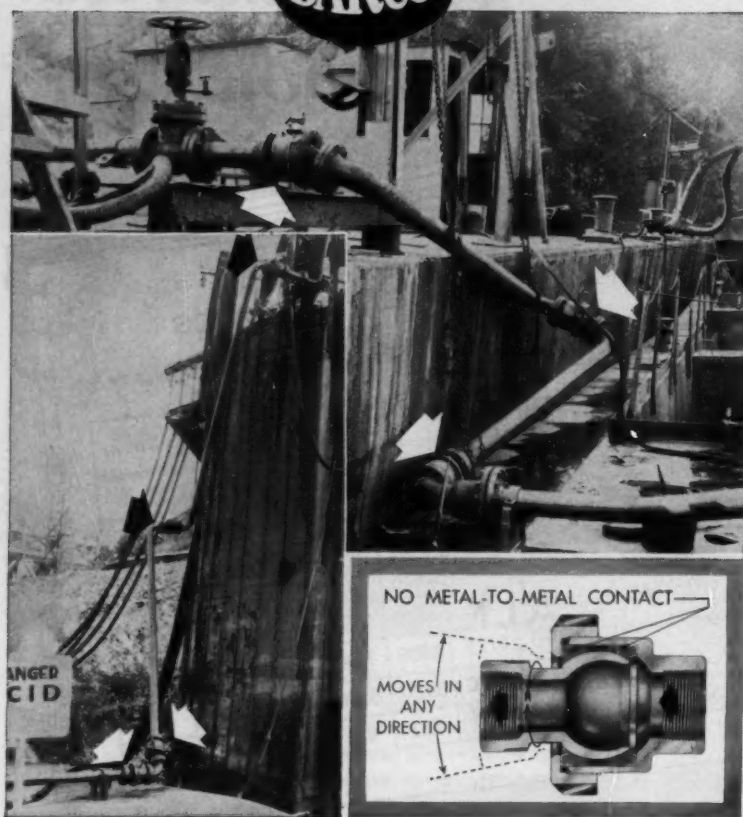
Heyl & Patterson

INC.

55 FORT PITT BLVD. • PITTSBURGH 22, PA.
PHONE COURT 1-0750



FLEXIBLE **BARCO** BALL JOINTS



Unloading Sulfuric Acid from Ohio River Barges

Major producers of chemicals recommend use of Barco Flexible Ball Joints and steel pipe when movable lines are needed for loading or unloading sulfuric, nitric, and other acids. This is why Weirton Steel Co. uses 4" malleable iron Barco flanged joints, with chemically inert No. 11 CT gaskets, for a sulfuric acid unloading dock on the Ohio River. The upper picture shows the 3-joint (see arrows) unloading line from permanent pump barge to to the incoming acid barge. The smaller inset photo, at left, shows the 4-joint line from pump barge to shore. This line may move as much as 30 feet up and down, depending on river level.

On this use Barco joints last for years, as contrasted with hose life of weeks or months. For recommendations, see our nearest representative or write.

BARCO *Manufacturing Co.*
516E Hough Street • Barrington, Illinois

LITERATURE . . .

Valves Issues new Catalog on special & standard valves for oil, steam, air, gas, water & process chemicals. Sectionalized in 7 bulletins & illustrated with detail drawings, schematic installation hook-ups, etc.
452A Atwood & Morrill Co.

Valves, Air Control Releases a quick-reference guide to 17 different lines of air-control valves & accessories. Helpful for quick, easy selection of the right Airmatic Valve to fit the specific application.
452B Airmatic Valve.

Valves, Diaphragm Trouble-free plastic diaphragm valves—choice of general-purpose Ace-Ite, Ace Parlan (polyethylene) or Ace Saran. Handles most corrosive chemicals & food ingredients. Bulletin 351.
326-7e *American Hard Rubber Co.

Valves, Diaphragm Describes Grinnel-Saunders diaphragm valve with straight-through flow. Includes advantages, maintenance, design, selection of bodies and bonnets, etc. Fully illustrated, 4 p.
16 Grinnell Co.

Valves, Diaphragm From antibiotics to the toughest acids, alkalis and salts, there is a combination of Hills-McCanna body and diaphragm materials that will best suit your needs. Request Valve Catalog.
229 Hills-McCanna Co.

Valves, Drain Offers descriptive information on line of Strahman ram type valves . . . the only drain valves that cannot clog up. Made in any cast metal to meet your requirements. Request complete Catalog.
L421 Strahman Valves.

Valves, Gate Offers data on sturdy, small forged steel gate valves. Super-hardened gate and seats assure tight closure, smooth operation and low maintenance. Complete information offered in Catalog No. 10.
14 Chapman Valve Mfg. Co.

Valves, Gate For pressures up to 150 lbs. & temperatures to 180° use iron body gate valves with permanently bonded hard rubber lining. In rising stem, cylinder or motor operated, or quick-opening types.
338 Darling Valve & Mfg. Co.

Valves, Globe Illustrated, 22 p. Gyro-seal Catalog describes product line: features (spinning disc, dual purpose seat, line contact between seat and disc); chemical and physical properties of materials; etc.
452C Richmond Foundry & Mfg. Co.

Valves, Lubricated Plug 28 p. catalog shows straightway, 3-way, 4-way, & multiple port lubricated plug valves for 250 lbs. oil-water-gas & 150 lbs. steam working pressure. Reference Book 39—5.
156 Homestead Valve Mfg. Co.

Valves, Lubricated Plug 36 p. covers complete line of iron and steel lubricated plug valves available. Many illustrations of single, screwed and bolted gland type valves are shown. Request Catalog No. PV-4.
51 Wm. Powell Co.

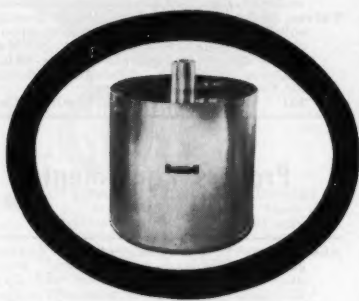
Valves, Needle The bar stock valve will contribute ease of operation, low maintenance cost and neat appearance to your equipment. Valves have an O-ring stem seal—operates at a touch. Request Bulletin.
445 Hoke Inc.

Keeping too busy?

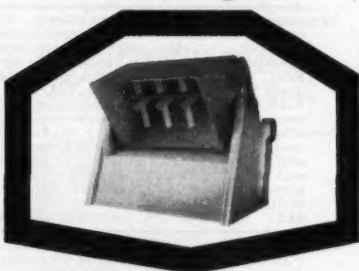
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*From advertisement, this issue

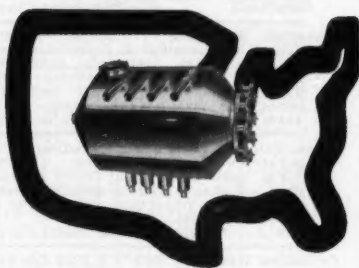
LITTLEFORD
STAINLESS STEEL
AND ALUMINUM
FABRICATED PRODUCTS
FOR THE
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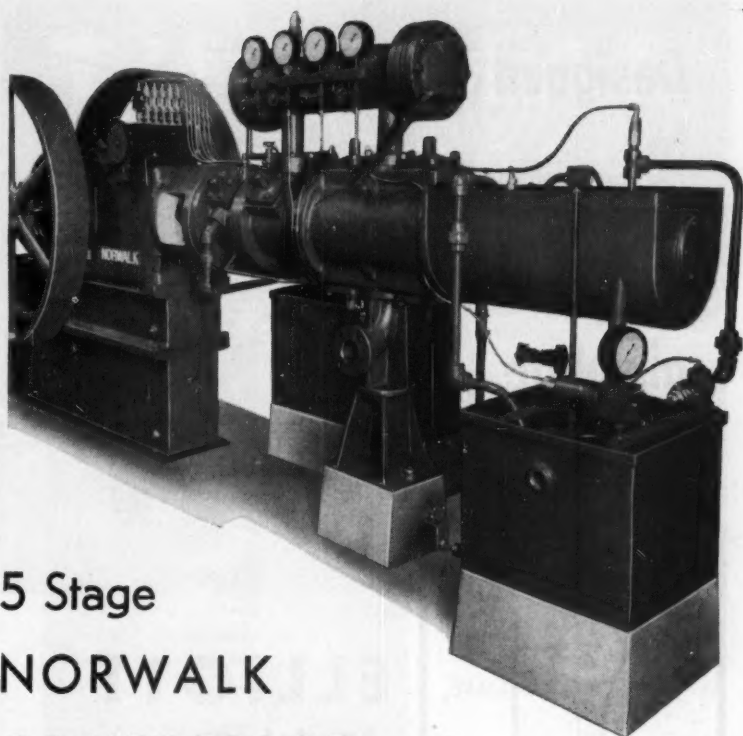
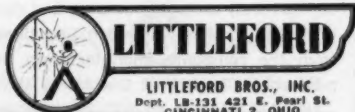


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NORWALK
COMPRESSOR**

built for economical performance

Frames with taper roller bearings, reversible ring plate valves, force feed lubrication, generous intercooler coils are some of the features that make this horizontal duplex compressor compact, sturdy, and efficient to operate. Its five stages develop 7500 pounds pressure.

Every Norwalk compressor is test-run for eight hours at the factory, then taken down for complete inspection before re-assembly and shipment. Complete catalog describing compressors from single stage to six stages available on request.

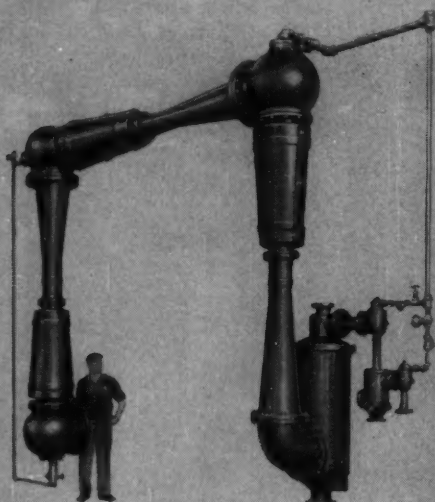


NORWALK COMPANY, INC.

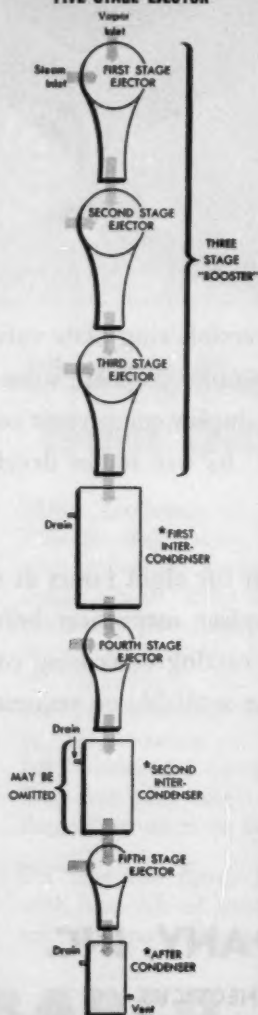
SOUTH NORWALK, CONNECTICUT

Makers of high pressure compressors since 1864

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to
maintain
low,
absolute
pressures



SIMPLIFIED SCHEMATIC of
FIVE STAGE EJECTOR



ELLIOTT Multi-Stage EJECTORS

When absolute pressures ranging from .012 in (0.3mm) to about .003 in (0.075mm) mercury are required, five stage ejectors such as the one shown above are applied.

Condensers of either the barometric or surface type can be incorporated in this five-stage hook-up. The after-condenser may be used to recover the heat of the steam, to recover the condensate, or to eliminate noise and nuisance at exhaust.

For details on the complete line of Elliott ejectors, contact your Elliott representative or write Elliott Company, Jeannette, Pa. for descriptive bulletins.



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LITERATURE . . .

Valves, Plug For special services—handling products that will harden or congeal at ordinary temperatures—Wedgeplug Valves can be supplied steam-jacketed. Offers full details in Wedgeplug Catalog 55-1-W.
89 *Wedgeplug Valve Co.

Valves, Porcelain Company makes available detailed literature covering the features and advantages of porcelain valves. Bulletin includes complete description, characteristics and specifications of product line.
361 *Lapp Insulator Co.

Valves, Solenoid New ASCO 2-way solenoid valve with explosion-proof enclosure—designed to meet NEMA VII & UL requirements—offers safe, automatic control. "Solenoid Valves for Corrosive Applications."
231 *Automatic Switch Co.

Process Equipment

Absorbers For absorption of hydrogen chloride and other gases. Produce as much as 20 tons per day 22° Baume acid. Pneumatic automatic control. Complete information in Catalog Section No. S-7460.
225f *National Carbon Co.

Agitators Illustrated reference describes the model ELB experimental agitator . . . the only agitator specifically designed for bench scale and pilot plant mixing operations. Request copy of Bulletin No. 109.
454A Chemineer, Inc.

Centrifugals, Continuous Maxi-Flex centrifugals easily adjusted for maximum throughput . . . quality of filtrate and cake. Enables Maxi-Flex to give more speed and efficiency. Request Bulletin.
423 *Tolhurst Centrifugals Div.

Centrifuges High speed dehydrating centrifuge offers precise external control of variations in flow rate, crystal size & slurry concentration & permits intermediate treatment of crystals. Bulletin No. 1257.
129 *Sharples Corp.

Classifier & Dryer Majac power-driven air classifier & dryer classifies & dries solid materials simultaneously, fractionates particles with 99.9% efficiency, removes moisture content as high as 20%. Data.
454B Majac, Inc.

Cloth, Filter If high operating temperatures are your problem . . . try NFM cloth made from Orion acrylic fiber. Makes available detailed literature on its important values plus a product sample.
462 *National Filter Media Corp.

Cylinders, Gas Safety & long life are prime considerations in the design of Harrisburg high pressure gas cylinders. Yet they are as light as sound engineering permits. For details, request literature.
BL353 *Harrisburg Steel Corp.

Demineralizers Produce chemically pure water for laboratory or small industry quickly, simply, economically with Kutlirlabs "Chemi-Filter." For complete production information, request illustrated Bulletin No. B-173.
454C Kutlir Labs.

*From advertisement, this issue

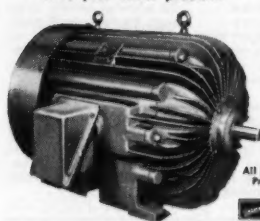
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Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the products.

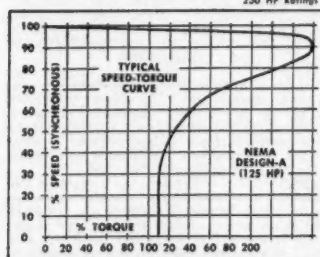
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- **EXPERIENCE of PROVEN PERFORMANCE** . . . over HALF A CENTURY. There is no substitute for the reliability of proven performance. Top Names of the Nation's Industry have proven ME performance in **ENGINEERING . . . DESIGNING . . . PRODUCING QUALITY PRODUCTS**
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- **SERVICE THROUGHOUT the NATION** MARATHON ELECTRIC has a DISTRICT OFFICE or Representative near you. Call your ME Representative TODAY to help solve your motor problem.



All ME Explosion
Proof Motors
Carry
Label In 1/12
HP Through
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EXPLOSION PROOF MOTORS

MARATHON ELECTRIC'S familiar ribbed frame construction has already been often copied but never duplicated. This carefully developed rib design formula has resulted in the COOLEST, CLEANEST, MOST EFFICIENT, and MOST COMPLETE RANGE of EXPLOSION PROOF MOTORS to carry the Underwriters' Laboratories Label. They are available in NEMA frame from 56 thru 680 series, from 1/12 thru 250 HP.

Write or Wire SPADE 40
for further information

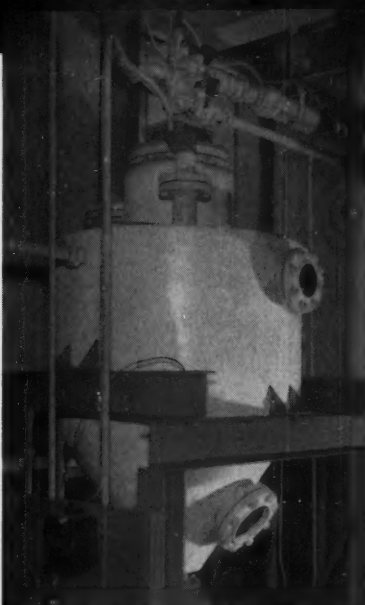
SALES OFFICES IN PRINCIPAL CITIES

MARATHON  ELECTRIC

HOME OFFICE AND FACTORY, WAUSAU, WIS.
FACTORIES AT ERIE, PA. AND EARLVILLE, ILL.

CHEMICAL ENGINEERING—April 1956

THERMAL SUBMERGED COMBUSTION



simplicity of
design and
construction . . .
plus extreme
compactness

HEAT INPUTS OF 250,000 BTU/hr to 5,000,000 BTU/hr

The high heat release rate of the THERMAL High Velocity burner used in these submerged combustion installations allows the use of a simple downcomer tube through which the products of combustion are discharged beneath the surface of the liquid. This arrangement is possible because combustion is 90% completed within the burner proper. The THERMAL burner is completely separate from the liquid being heated and maintenance, control and accessibility are greatly simplified. Equally simple arrangements are possible with gas, oil or combination fuel.

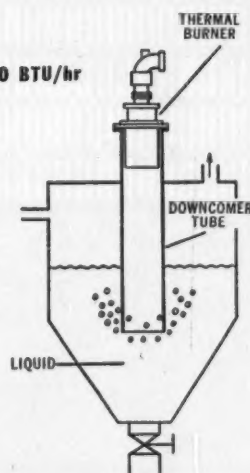
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Depending upon the material being heated either a metal or refractory downcomer tube may be used. Some of the more common applications are pickling baths, acid concentration, caustic soda concentration, aluminum sulphate concentration, water recarbonization, and glass frit and molten salt heating.

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Gas, Oil & Combination Burners
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& Heat Transfer Equipment



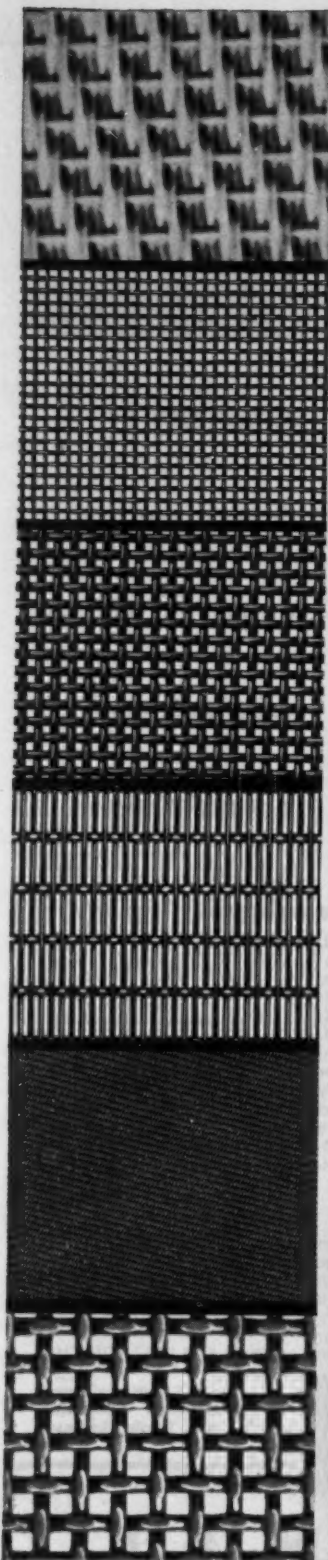
WRITE FOR BULLETIN #110

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Write for Condensed Screen Reference Catalog

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Ave. • West Coast: Star Wire Screen & Iron Works, Inc., 2515 San
Fernando Rd., Los Angeles • Subsidiary, Ludlow-Saylor Wire Cloth Co.

1856



1956

LITERATURE . . .

Demisters. . . . Illustrated Brochure covers "ACS" line of demisters. Includes: what a demister is; how it works; why it is used; what demister materials are used; where a demister is used; how a demister performs; etc. 456AA *American Copper Sponge Co.

Dryer-Blenders. . . . The conical, rotating dryer-blenders give you speed, ease & efficiency for drying & blending a broad range of corrosive & heat-sensitive materials, using either steam or hot water. Request details. 211 *Glascote Products.

Dryers, Spray. . . . Features: high recovery of solids, low initial cost, low cost of operations, easy to clean, low maintenance cost, & controlled characteristics of the dry product. Details in Bulletin 373. 364 *Bufflovak Equipment Co.

Drying Equipment. . . . To improve your product call on Proctor & Schwartz who not only manufacture drying equipment, but have the know-how to help you in materials handling problems. Request Bulletin 390. 24 *Proctor & Schwartz.

Drying Systems, Flash. . . . Systems offer means for handling materials in which drying is combined with pulverizing, or with mild disintegration, or followed by cooling & conveying product to storage. Catalog 82. 314 *Raymond Div.

Dust Collectors. . . . Completely illustrated bulletin describes the numerous advantages and design features of the Simon Suction Filter Dust Collector and the Entoleter Impact Mill. Request your copy of Form 4722-7-54. 456A Safety Car Heating.

Dust Collectors. . . . In almost every type of industry . . . users have found high efficiency, simplicity & economy of Dustube collectors a difficult combination to equal for top performance. Bulletin No. 372. 18 *Wheelabrator Corp.

Dust Collectors. . . . New booklet, "The Collection and Recovery of Industrial Dusts" is available upon request. It describes the "SF" electric precipitators and how they meet all 5 basic requirements for top efficiency. 86 *Buell Engrg. Co.

Dust Collectors. . . . Describes features of the Majac power-driven dust collector & fractionator; separates particles down to .1 micron; operates wet or dry; functions at temperatures to 800° F; etc. Illustrated. 456B Majac, Inc.

Eductors, Water Jet. . . . New reference adds to previously published data on SK water jet eductors. Includes data on application, construction, operation, installation, and sizes available. Bulletin Supplement No. 2M. 456C Schutte & Koerting Co.

Ejectors. . . . Elliott's 5-stage ejectors are applied when absolute pressures ranging from .012 in (0.3mm) to about .003 in. (0.075mm) mercury are required. For details on complete line, request Bulletin. 454 *Elliott Co.

Ejectors, Steam-Jet. . . . Presents a 60 p. "Steam-Jet Ejector Application Handbook" for selection of single and two-stage stock ejectors for general vacuum service. Photos, tables, graphs, etc. Bulletin W-205-E21. 223 *Worthington Corp.

Filters. . . . New built-to-order vertical filters solve complex problems & are easily adapted for special uses. For detail, on flow systems, special equipment, filter & leaf construction, request Bulletin No. 111. 337 *Industrial Filter & Pump.

Filters. . . . Cuno's new Super Auto-Klean filter now makes possible economical, compact, micronic filtration at high flow rates & eliminates the need for replacement cartridges. Request Catalog SAK-057. 254 *Cuno Engrg. Co.

*From advertisement, this issue

Filters.....The Elmco-Burwell filters, available in plate and frame types, offer automatic, practically continuous filtration. Company makes available complete technical data on filtration of products.
57 *Elmco Co.

Filters, Pressure Leaf.....For flow rates two to five times greater than cloth covered presses; positive removal of all suspended solids to desired degree of clarity; etc. Find details in Catalog No. NC-1-53.
422 *Niagara Filters Div.

Generators, Inert Gas.....Assures a safe, dependable supply of chemically clean inerts. Deliver inerts at a special analysis... without fluctuations. For facts and technical data, request Bulletin 1-10.
253 *C. M. Kemp Mfg. Co.

High-Pressure Equipment.....Equipment described in new 100 p. catalog embraces pilot plants, reaction vessels, fittings, valves, tubing, pumps, compressors, instruments, etc. Request Catalog 106-D-34.
BL351 *American Instrument Co.

Kilns, Rotary.....Efficient thermo-processing of products. Used in the production of lime, bauxite, cement, sodium silicate, alumina, etc. Complete data on design features offered in illustrated Bulletin 115.
362 *Taylor Engrg. & Mfg. Co.

Mills.....Illustrated reference. "The Kady Mill," describes the numerous features: highest production rates; fastest loading & unloading; best color or hiding-power development; most versatile; etc. 16 p.
457A Kinetic Dispersion Corp.

Mills, Ball & Pebble.....Valuable references give complete details on the Abbé Engineering series of mills for every range of work from small batch jobs to full scale plant production. Catalogs Nos. 73 & 77.
442 *Abbé Engrg. Co.

Mills, Disc Roll.....Particularly suited for grinding relatively soft minerals, such as limestone, coal, bauxite, talc, etc. Describes details of operation and application of mill in thoroughly illustrated 8 p. Bulletin No. 52.
457B Hardinge Co.

Mills, Roller.....Positive and continuous precision size control at exceptionally high production rates are but two of the numerous features of Williams Roller Mills. Request fully descriptive new Catalog.
25a *Williams Patent Crusher.

Mixers.....Company makes available Confidential Mixing Data Sheet. Helpful checklist enables you to develop a complete technical description of agitation required for your process, quickly & easily. No. B-107.
203a *Mixing Equipment Co.

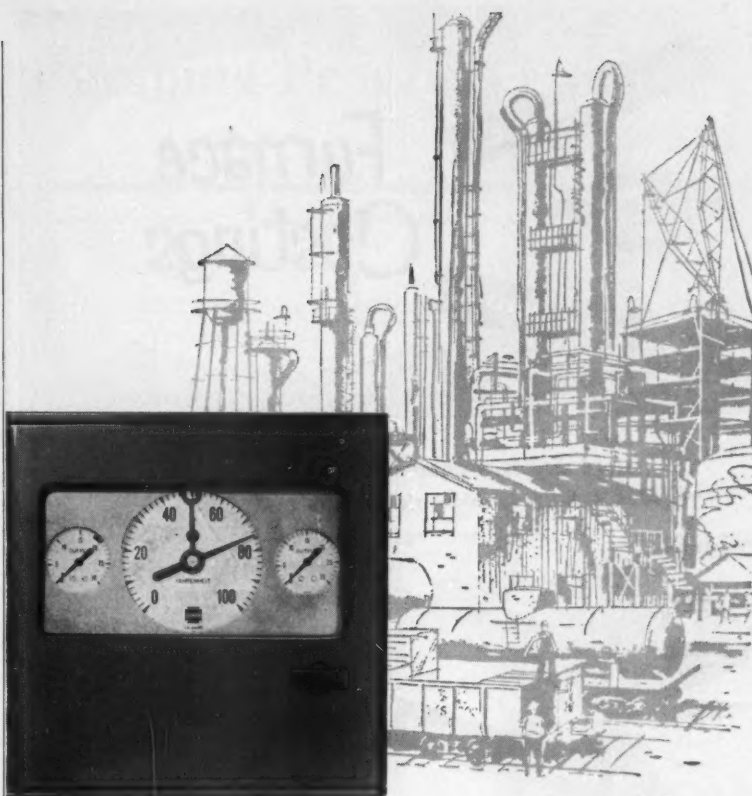
Mixers.....Mix-Mullers for chemical and process industries. Covers Simpson mulling principle; mulling for dry, wetted and plastic mixtures; Mix-Mullers for special requirements; etc. "Handbook on Mulling."
369 *National Engrg. Co.

Mixers.....New—broad in application—standardized for low cost. Four different models, for propeller, turbine, gas absorber and other mixing elements. Details in fact-filled Unimixer Bulletin.
335 *Patterson Foundry & Mach.

Mixers.....Eastern's mixers are designed to meet the needs of today's chemical and industrial processes. Covers portable mixers, top and side entering mixers, turbine mixers, etc. in Catalog Series No. 26.
372 *Eastern Industries.

Mixers.....Powered by a 50 hp. silent chain drive motor, the No. 15 is constructed of stainless steel, & jacketed to carry 125 psi pressure of steam or water. Working capacity is 100 gals. Request Catalog.
23 *Baker Perkins.

*From advertisement, this issue



PATENTS APPLIED FOR

NEW Temperature Pilot *with automatic reset*

Temperature, Reset and Expanded Ranges feature the enlarged U. S. Gauge line

The exclusive USG indicating, mercury-actuated temperature pilot is available in ranges from -40°F. to $+1000^{\circ}\text{F.}$

Pressure and Temperature Pilots are available with or without automatic reset. When process conditions change, conversion kits make possible addition of automatic reset to existing installations.

With the new USG nested diaphragm pressure elements, vacuum and low pressure pilots never before available are now standard.

Only U. S. Gauge offers pressure pilots in ranges as low as 30 inches of water... as high as 10,000 pounds.

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Division of American Machine and Metals, Inc., Sellersville, Pa.

35% NICKEL

DURALOY

15% CHROMIUM

Furnace Castings

Here are two good examples of our work
in high-nickel castings!



These are in the Duraloy HT group calling for Ni 33.37 percent. We've gone as high as 68% nickel on some castings where extremely high temperatures and very severe corrosive conditions had to be resisted. The important factor concerning castings for exceptionally high temperatures is that they must retain their structural form under load.

Knowing just how much nickel to put in and how much chromium and other alloying elements depends to a large extent on experience . . . and it is experience that we can offer you for the castings you need. We've been producing static castings since 1922 and centrifugal castings since 1933, being among the pioneer founders in each class.

If you would care to have our metallurgist study your casting problem, we shall be glad to have you call upon us for the service.

Our New General Catalog is yours for the asking.

THE DURALOY COMPANY

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CHICAGO OFFICE: 332 South Michigan Avenue



LITERATURE . . .

Mixers. Company's line of Jumbo mixers meets every requirement imposed by heavy loads. Standard-duty mixer is equipped with two roller bearings mounted on heavy fabricated supports. Bulletin 800.
339 *J. H. Day Co.

Mixers. Nauta Mixer features uniform, quick mixing of any number of dry materials, similar or entirely different in characteristics. Describes features and industries where it is profitably used. Catalog 374.
458A Buflovak Equipment Div.

Mixers, Paper Coating. Readco paper coating mixers can be supplied for manual or hydraulic discharge in 150, 350 and 750 gallon working capacities. Request product literature for complete details.
321 *Read Standard Corp.

Mixers, Portable. Use in industry reduces cost, saves time, labor and secures better and more refined products. Catalog includes data on construction, dimensions, specifications, etc. 28 p. No. B-108.
203d *Mixing Equipment Co.

Mixers, Side Entering. Furnishes detailed information on features, typical applications, mechanical design, maintenance, shaft seals, methods of installation, etc., in completely illustrated Catalog B-104.
203e *Mixing Equipment Co.

Mixers, Top Entering. Illustrated and detailed 32 p. Catalog includes advantages, typical installations, mechanical description, construction information, dimensions and selection tables, etc. Catalog No. B-102.
203f *Mixing Equipment Co.

Mixers, Top Entering. Makes available pertinent information on top-entering mixers (propeller type) . . . for closed tanks, pressure & vacuum . . . for open & loose-covered tanks. Data in Catalog No. B-103.
203g *Mixing Equipment Co.

Molding Machines. The Vogt automatic tube-type molding machine forms and sizes any liquid that will solidify when cooled, and will discharge by gravity without heating. Technical information available.
205 *Henry Vogt Mach. Co.

Pelletizers, Continuous. Produce top-quality pellets in tremendous volume at reasonable investment & low operating cost. Large & small pellets—even 1" cubes—in many shapes & sizes. Complete details.
247 *Sprout-Waldron & Co.

Presses, Dewatering. The variable speed continuous dewatering press extracts surplus moisture economically from products having physical properties of a fibrous nature. For information, request Catalog A.
TL343a *Davenport Mach. & Fdry. Co.

Process Equipment, Fabricated. For your most efficient means to fast, economical production, for individualized equipment designed & constructed to fit your needs, request a copy of Koven's Bulletin 550.
153 *L. O. Koven & Bro.

Processing Equipment. Describes corrosion-resistant processing equipment . . . precision built to your specific requirements to give long years of peak performance with low maintenance. Technical Bulletins.
342 *Lee Metal Products Co.

*From advertisement, this issue

Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the product.

Processing Equipment, Liquid.....Presents a fully illustrated, 32 p. reference describing "Sealed-Disc" and "Disc-Pak" filters, transfer pumps, portable mixers, tanks, agitators, etc. Request Bulletin No. G-255.
459A Aisop Engrg. Corp.

Pulverizers.....Valuable data on Super-fine pulverizer... a centrifugal air attrition impact pulverizer and classifier in a single unit. Covers numerous features, specifications, construction, etc. Illustrated.
431 *Schutz-O'Neill Co.

Reclaimer Systems, Oil.....A simple, economical and efficient method of restoring contaminated lubricating and sealing oil to the full value of new oil. Offers full details on reclaimers in Bulletin R-160.
346 *Hilliard Corp.

Scrubbers, Fume.....Engineering News-Letter (Volume 1—Number 1) tells how the SK Fume Scrubber provides simple, inexpensive solution to a manufacturer's hot air and ammonia fume problem. Fully illustrated.
459B Schutte & Koerting Co.

Separators, Laboratory.....Company manufactures new laboratory machines which aid chemical process research and development. Complete technical information on these laboratory separators available upon request.
330 *Superior Separator Co.

Tank Equipment.....Issues a new general catalog covering tank equipment, gas control, safety devices, automatic controls, electronic remote liquid level gaging and pulse code telemetering systems. Vaptec Catalog No. P-7R.
459C Vapor Recovery Systems Co.

Thickeners.....The higher the solids content in the thickener underflow, the lower the cost of filtering for subsequent processing or disposal. Specifications on the "Auto-Raise" in Bulletin 31-D-11.
322 *Hardinge Co.

Traps, Pumping & Lifting.....Brochure describes the Johnson Electrap for: pumping service; lifting service; vacuum service (draining vacuum line). Covers operation, features, capacities, etc. Bulletin No. ET-2.
459D Johnson Corp.

Washers, Fume.....The cyclonaire is only a fraction of the size of custom built units of comparable capacity. It is a wet bed scrubber and is packed with Intalox saddles. For details, request Bulletin FW-102.
102 *U. S. Stoneware.

Wire Cloth.....Produces standard replacement or custom-designed filter leaves or units, strainers, screens, trays, baskets, cylinders, semi- or complete process apparatus of any desired metal. Catalog No. 50.
Br332 Multi-Metal Wire Cloth Co.

Pumps, Blowers, Compressors

Blowers.....Precision manufactured to move more gas or air with less wear than other blowers of equal size or weight... and with less maintenance and power costs. Describes line in detailed Bulletin B-154.
444 *Read Standard Corp.

Compressors.....All types of air and gas compressors used in the process and chemical industries are shown in a new, three-color reference, entitled, "Compressors for the Process Industries." Bulletin Form 3132-A.
459E Ingersoll-Rand Co.

Compressors.....Describes Allis-Chalmers single & two-stage vane type compressors for shop air, gas handling, drilling & numerous other applications. Request Bulletins 16B8244 & 16B8126.
307 *Allis-Chalmers Mfg. Co.

*From advertisement, this issue

Pumping Progress Report

FOR CHEMICAL ENGINEERS

An advertisement prepared by the Aldrich Pump Co., Member of Hydraulic Institute, U.S.A.

PUMP INSPECTION, MAINTENANCE AND REPAIR are jobs too frequently ignored in the design of production pumps. This has been verified by a survey of more than 15,000 pump installations. Speed and economy of maintenance was frequently quoted as a major factor in pump selection.

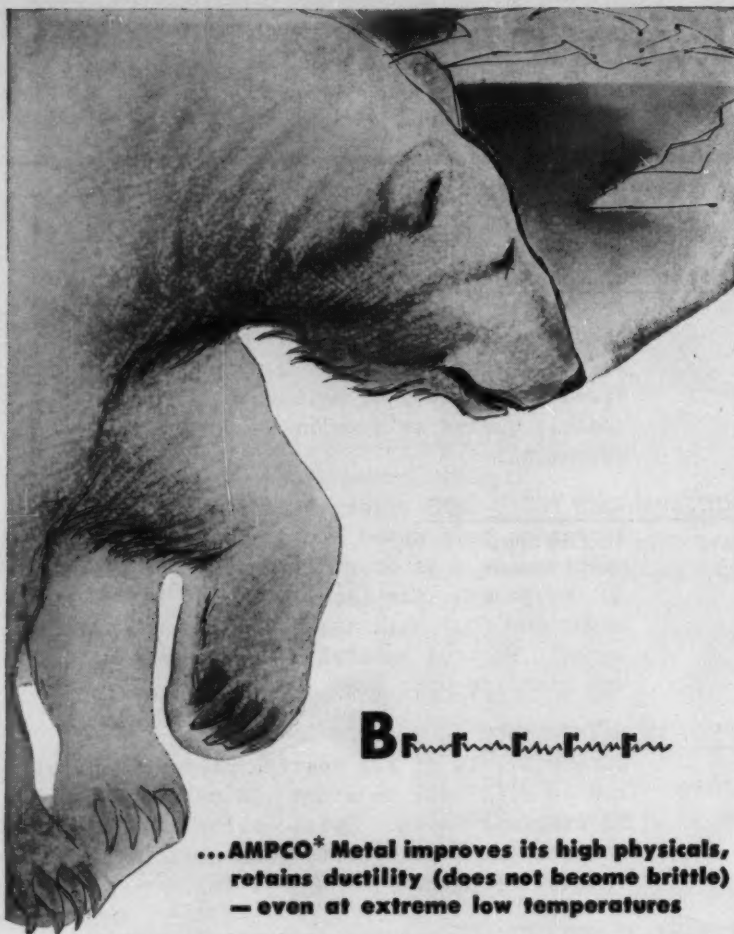
SECTIONALIZED FLUID-ENDS offer one of the best ways to guarantee both speed and economy in pump maintenance. As originated by ALDRICH Pump Co. Engineers, the Sectionalized Fluid-End comprises four main assemblies — the working barrel, suction manifold, discharge manifold and stuffing box.

SPEED IN MAINTENANCE is assured because of ease of accessibility of all wearing parts. Manifolds can be slid back on studs and valves removed as complete units. Split collar and flange connection of plunger to yoke permits easy removal of plunger.

ECONOMY OF MAINTENANCE results from speed in maintenance. Perhaps even more important is the simple fact that it is cheaper to replace a single section than a complete fluid-end. Another important economy is parts interchangeability. Among 3-, 5-, 7- and 9-plunger units of any series, wearing parts are interchangeable. Where a combination of multiplex pumps is required, this reduces spare parts stocks.

THE ALDRICH PUMP COMPANY is the originator of the **DIRECT FLOW** principle — a design innovation that utilizes the sectionalized fluid-end principle. Aldrich Engineers have become known as the people to take your tough pumping problems to. We have never turned down a challenge.

FURTHER INFORMATION can be had direct from the company. Tell us your problem and we'll send you Data Sheets describing the size pump we recommend to solve your problem. Address your request to: The Aldrich Pump Company, 3 Gordon Street, Allentown, Pa.



B r i t t l e

...AMPCO* Metal improves its high physicals, retains ductility (does not become brittle) — even at extreme low temperatures

Its ability to perform dependably under conditions of extreme cold without becoming brittle is one of Ampco Metal's more unique properties. And it's one that really pays off for designers of Arctic equipment, gas liquefying machinery, refrigeration equipment, low temperature chemical processing, and similar applications. Tests made with Ampco Metal at temperatures as low as -400° F. show that it remains ductile, retains its high mechanical values, even in this brutal, punishing cold.

But the Ampco story doesn't stop there. This series of remarkable alloys gives you high strength-to-weight ratios — tensiles to 110,000 psi with 10 to 15 percent less weight than ordinary bronzes. It combats corrosion, fatigue, erosion, wear.

All the advantages of one of the world's most versatile metals are yours when you specify Ampco Metal. Get full information from your nearby Ampco field engineer or write us.



Sole Producer
of Genuine
Ampco Metal
*Reg. U. S. Pat. Off.

AMPCO METAL, INC.

Dept. CE-4

MILWAUKEE 46, WIS.

• West Coast Plant: BURBANK, CALIF.

LITERATURE . . .

Compressors. Reversible ring plate valves, force feed lubrication, sealing type piston rings, generous intercooler coils are features which make for efficiency and long-term economy. Descriptive Catalog.
R453 *Norwalk Co.

Compressors. Carbon piston compressors give oil-free air with no maintenance penalty. The self-lubricating carbon does away with any need for oil in the cylinder. Company offers details in Bulletin CRC-10.
56 *Gardner-Denver Co.

Compressors. Spiraxial compressors built with R-C plur-ability have ranges of 700 cfm. to 5,000 cfm., and pressures from 15 psi to 30 psi (or higher). Company offers details in new Bulletin No. SC-354.
435 *Roots-Connersville Blower.

Compressors, Balanced/Opposed. Illustrated, 36 p. describes 300-10,000 hp balanced/opposed compressors—basic principles, drive, design, running gear, lubrication, capabilities, etc. Bulletin L-679-B1.
304 *Worthington Corp.

Compressors, Oil-Free. The WGO-9 offers space-saving design, excellent service, economical operation, etc. Company builds regular & oil-free compressors to meet capacity & pressure needs. Bulletin 57-11.
8 *Joy Mfg. Co.

Compressors, Rotary. The revolving principle in both single and two-stage types, provides impressive cost, maintenance and operating advantages. Company makes available literature on its line.
65 *Fuller Co.

Fans. Publishes valuable reference covering Class III fans . . . especially designed for high velocity air conditioning systems. They are also ideally suited for industrial use. Request Bulletin No. DS-348-C.
460A Trane Co.

Fans. The Bifurcator is a direct-driven fan in a divided housing. Fumes bypass the motor which always stays clean, cool & accessible. Installs like a section of duct-work . . . at any angle. See Catalog DB-37-55.
209 *Debothezat Fan Div.

Fans. Exceptional fan equipment for industrial air & material handling features: high efficiency; rugged, tight construction; 3 interchangeable wheels—each with radial blades; etc. Illustrated Bulletin 702-A.
61 *Clarage Fan Co.

Fans. "Buffalo" Type BL Limit-Load Ventilating Fan offers the finest performance—for quiet, stable, efficient performance in industrial service. Further details in Bulletin F-100, your copy on request.
66 *Buffalo Forge Co.

Fans. The series 106 fans feature: certified ratings, pressures to 18" w.g., volumes to 125,000 cfm., heavy construction, choice of 3 special-duty wheels, etc. Available in 16 sizes. Request Bulletin 5306-H.
41 *American Blower Corp.

Intensifiers & Pumps, High Pressure. Thoroughly illustrated, 30 p. describes outstanding features and advantages of Harwood laboratory and industrial high pressure intensifiers and pumps . . . 5000 to 350,000 psi.
460B Harwood Engrg. Co.

Lubrication Systems. The air-operated transfer pump cuts costs in your plant . . . transfers 27 lbs. of pressure gun grease per minute while sealing the lubricant at all times. "5 Plans for Better Lubrication."
239 *Alemite Div.

Pumps. In the Corson-Cerveny Micro-Bellows pumps, the motor is totally enclosed and sealed . . . explosion proof. Maximum working pressure of 500 lbs. Stainless steel parts. Company offers details.
TL355 *Research Appliance Co.

*From advertisement, this issue

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PULLEYS**



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SPEED**

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HERE'S WHY:

- **ECONOMICAL** IN COST compared to other variable speed transmission equipment. Simple in design but rugged in construction to give you long dependable service.
- **EASILY INSTALLED** on new or old equipment. Just as easy to operate. Finger-tip adjustment gives the right speed instantly.
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are available in a complete range of sizes from fractional to 15 hp., ratios to 3 to 1.

Shown is a typical Lovejoy counter-shaft unit controlling speed of automatic spring coiler.

Lovejoy Select-O-Speed Transmissions

can be supplied with hand wheel or lever control. Fractional to 5 hp., ratios to 10 to 1.

This Lovejoy Select-O-Speed is used to control the speed of a printing press.



For your variable speed application, there is a type and size Lovejoy unit that will give you initial economy, dependable performance and long service life.

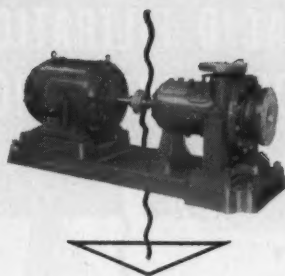
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Pulleys and Transmissions, Motor Bases and
Universal Joints.



*How to have a Big Family
... and be happy, too*

We're talking about a "family" of pumps for a process plant.

It's Dean Brothers Series 10 standard centrifugal pumps. The eleven members of this family can do almost anything in the way of moving liquids. They can pump as little as 10 gallons a minute or as many as 700. Total dynamic head can be anything from 25 feet up to 400. The temperature of the liquid can be as low as 250° F. below zero or as high as 850° above. Working pressures range from a 30-inch vacuum to 400 lbs. per sq. in., gauge.

But the thing that makes these pumps one big happy family will make you happy, too. They're all built from the same parts with the exception of the Casing, Impeller and Suction Nozzle. And for pumping temperatures above 350° F., the cradle housing is integrally water-jacketed. Otherwise, these pumps are all alike. One shaft fits all pumps. Likewise one shaft sleeve and one set of packing or one mechanical seal. The bearings are the same and so are all other parts throughout the entire family.

When you get all this—plus mechanical reliability usually found only in costly, individually-engineered pumps—who wouldn't be happy with a family of Dean Brothers standard centrifugal process pumps? Why don't you get all the facts about these truly remarkable pumps? * Send for Circular No. 184B.

*Series 10, Series 20 and Series 30—to 7,000 gallons per minute capacity.



HOW PUMPS, "FAMILY STYLE," PAY OFF

Initial cost is lower than if each pump was an "individualist."

Factory assembly from *parts in stock* assures prompt delivery.

Spare parts inventory is small—less investment . . . less storage space . . . less time to handle and keep track of.

Maintenance time is reduced. Once a man learns his way around one pump, it's the same for all the rest. In emergencies, this can mean less downtime.



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. . . for your Filter Paper requirements try NETONE Filter Paper. High tensile strength, chemical resistant, high burst factor, abrasion resistant and crease resistant. Send for a test sample.

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††TM for duPont Polyester Fiber
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No loss of strength after 32 days exposure to air at 257° F.



Shrinkage not more than 2 1/2 % in water at 212° F.



Good resistance to hot mineral acids, weak alkalis, common solvents, oils, greases, neutral salts, most acid salts and chlorine.



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LITERATURE . . .

Pumps. . . . Viking pumps deliver non-leak operation and positive pumping. Company makes available a bulletin which gives complete details on its product line. Request Bulletin Section Hc.
TL351 *Viking Pump Co.

Pumps. . . . Selected sizes of B & G series 1522 and 1531 centrifugal pumps are stocked at the factory for immediate shipment. Capacities to 225 gpm, heads to 140 ft. Price and Selection Catalog.
157 *Bell & Gossett Co.

Pumps. . . . Handle most anything that can pass thru a pipe, from free-flowing liquids to non-pourable pastes—even materials containing relatively large particles or abrasives. Moyno Pump Bulletin No. 30-CE.
47 *Robbins & Myers.

Pumps. . . . Information on the number of rings, depth of box, type of packing . . . chemical & physical properties of fluid being pumped, speed of shaft & other usable facts, in Pump Bulletin No. S-147.
L429 *Taber Pump Co.

Pumps. . . . Describes Wheeler-Economy Type M Pumps for medium and high head services. Includes the advantages of high efficiency and low maintenance in addition to details of construction. Illustrated Catalog No. A-155.
462A C. H. Wheeler Mfg. Co.

Pumps, Acid. . . . Announces a new portable electric acid pump (Centri-F Pump) which conveniently and safely transfers acids from open vessels as well as from standard carboys and drums. Request complete information.
462B General Scientific Equipment.

Pumps, Acid. . . . 80-gpm. centrifugal pump with hard rubber casing and impeller, Hastelloy C shaft. Handles nearly all corrosives. Mechanically simple, trouble-free. For information, request Bulletin CE-55.
326-7d *American Hard Rubber Co.

Pumps, Acid. . . . On most difficult pumping jobs . . . dependable highly efficient pumps deliver continuous, trouble-free performance on round-the-clock schedules wherever they are installed. Full details.
81 *A. R. Wilfley & Sons.

Pumps, Acid, Submersible. . . . Illustrated reference describes line of submersible acid pumps with vertical shaft for pumping acids or slimy liquids from containers, tanks, pits, etc. Includes constructional features.
462C Neumann & Welchman.

Pumps, Centrifugal. . . . The Series 10 standard centrifugal pumps are built from the same parts . . . one shaft fits all pumps. For more complete information, request a copy of Circular No. 184B.
R461 *Dean Bros. Pumps.

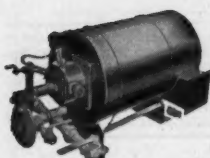
Pumps, Centrifugal. . . . Specially built centrifugal pumps are used to handle abrasive & corrosive sludges, slimes & slurries. They give maximum pumping service for years. Descriptive Bulletins available on request.
356 *McNally Pittsburg Mfg. Corp.

Pumps, Centrifugal. . . . Impervious graphite pumps feature mechanical seal with inclosed coolant, rugged type SN armored connections, interchangeable parts, wide capacity range, etc. Catalog Section S-725.
225a *National Carbon Co.

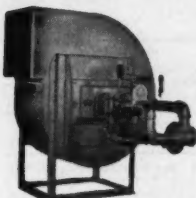
Pumps, Centrifugal Chemical. . . . Describes new Worthite Self-Priming Centrifugal Chemical Pumps. Includes data on maximum interchangeability & coverage, minimum spare parts requirements, etc. Bulletin W-350-B13.
54-5 *Worthington Corp.

Pumps, Centrifugal, Sealless. . . . Describes Series DE (Double Ended) Chempumps—newest addition to line of seal-less "canned" motor centrifugal pumps. Performance, diversion & operation principles. Bulletin 1020.
462D Chempump Corp.

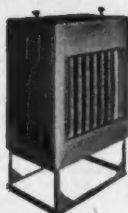
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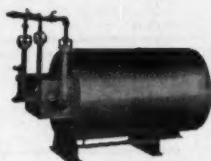
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direct air heater

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Here's a sure way to save fuel and space wherever a chemical process requires convection type heating. Specify "Surface" air heaters and get these returns:

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Save installation costs with compact design and complete air heater assembly.

Single burner unit requires only one safeguard system for each air heater installation.

Build these savings into your convection heating equipment now. Call your "Surface" representative, or write for Literature Group H54-15.

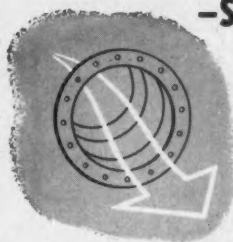


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-STILL THE BEST VALVE YOU CAN BUY

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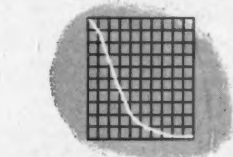
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Full line opening means less head loss, lower pumping costs.



EASIEST TO OPERATE

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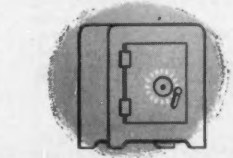
GREATEST INITIAL SHUT-OFF

Rotovalve 55% closed at 25% stroke, and 92% closed at 50% stroke. In comparison, gate valves only 18% closed at 25% stroke and 43% closed at 50% stroke.



MOST CONTROLLED CLOSING TIME

Closing as quickly as one second or as slow as needed. Fast initial closing limits reversal of flow.



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Drop-tight, positive closing. Self-purging, monel-to-monel seating. Pressure-tight bolted head, stuffing box, and machined and lapped seats.

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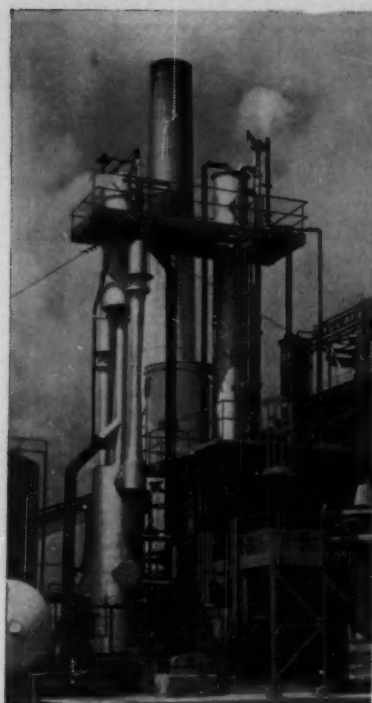
For detailed information about SMS Rotovalves, Ball or Butterfly Valves, see our local representative or write to the S. Morgan Smith Company, York, Pennsylvania.

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By converting waste steam to efficient refrigeration, this new C. H. Wheeler Steam Jet equipment cools process water for a chlorine dioxide absorber. It is an important part of the modern bleaching process recently installed at the Foley, Florida plant of Buckeye Cellulose Corporation. This C. H. Wheeler unit cools process water from 70° F to 40° F at the rate of 150 gallons per minute with a capacity of 194 tons. It operates 24 hours a day with practically no maintenance, because the only moving part is the chilled water pump. There is no noise . . . no vibration . . . no wear.

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LITERATURE . . .

Pumps, Chemical. . . . Offer new features that make them rugged, dependable, long-lived pumps for handling corrosive liquids. In 3 sizes providing capacities up to 720 gpm & heads up to 200 ft. Bulletin 725.4.
266 *Goulds Pumps.

Pumps, Chemical. . . . Furnishes a complete line of Buffalo pumps, ready to handle corrosive or abrasive liquids at least maintenance cost. For full product information, request illustrated Bulletin 982.
436 *Buffalo Pumps.

Pumps, Chemical. . . . Announces a new, all-purpose chemical pump . . . the OKM-Model 100-C. Includes: description; operation; lubrication; primary uses; special equipment; specifications; etc. Illustrated Brochure.
464A O. K. Mach. & Tool.

Pumps, Condensate & Vacuum. . . . Describes new Sarco Type S Condensate Pump & the complete line of vacuum & condensate pumps. Features cut-away illustrations, pump selection guide & installation diagrams. Bulletin 1465.
464B Sarco Co.

Pumps, Diaphragm Slurry. . . . Self-contained unit features dual-ball check valve design & variable-speed drive, permitting gentle pumping action, positive feed & metering characteristics, etc. Bulletin No. KSP-1.
464C Komline-Sanderson Engrg.

Pumps, Direct Flow. . . . The Direct Flow principle, an Aldrich design innovation, is a major forward step toward the solution of tough pumping problems of all kinds. Request descriptive Data Sheets.
459 *Aldrich Pump Co.

Pumps, Fire. . . . Fully describes & illustrates new underwriters' approved fire pumps. Includes complete fire pump selection charts & a set of "typical" fire pump specifications. Request new 38 p. Bulletin No. B-150C.
464D Peerless Pump Div.

Pumps, Gear. . . . SK Gear Pumps pump many types of materials . . . alcohol, molasses, coolants, fuel oils, soup, road tars, kerosene, varnish, lube oils of all grades, wax, etc. Details of line in Bulletin No. 17A.
464E Schutte & Koerting Co.

Pumps, High Pressure. . . . Completely illustrated reference describes line of Gaulin High Pressure Horizontal Triplex Pumps. Includes data on construction, operation, features specifications, etc. Bulletin P-55.
464F Manton-Gaulin Mfg. Co.

Pumps, High Vacuum. . . . Describes Kinney high vacuum pumps . . . for every industrial and scientific application. Product line is the largest of any in the world. For complete information, request Bulletin 405.
299 *Kinney Mfg. Div.

Pumps, Liquid Oxygen. . . . Uses metals not affected by extreme low temperature & locates the packing far enough above the liquid so it is exposed only to the oxygen vapors & functions normally. See Bulletin 203-7.
443 *Lawrence Pumps Inc.

Pumps, Process. . . . DeLaval CPO-process pumps handle numerous liquids; salt brine; sea water; caustic solution; soap solutions; etc. Capacities to 2000 gpm—heads to 200 ft. Details in Bulletin No. 1125-B.
243 *De Laval Steam Turbine Co.

*From advertisement, this issue

Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the product.

Pumps, Wet Pit......Illustrated, 16 p. covers line of heavy duty wet pit pumps for applications such as drainage, flood water, effluent boiler blow-off, hot wells, acids & alkalis. Request Catalog No. 3007.
465A Yoemans Bros. Co.

Services, Processes, Misc.

Autopositive Paper......Describes Kodak-graph autopositive paper—the "big new plus" in engineering drawing reproduction. "New Short Cuts & Savings" shows all the ways you can save with autopositive paper.
68 *Eastman Kodak Co.

Copy Makers......Apeco Dial-A-Matic all-purpose copy maker features relaxed, automatic copying of absolutely anything with the speed of automation, picture-sure accuracy, & at an economical cost. Illustrated Folder.
465B American Photocopy Equip.

Engineering Services......Help protect your equipment investment—application engineering, analytical engineering, product development, field-service engineering, maintenance service, etc. Buis. GED-2244, GED-1966 B.
100-1 *General Elec. Co.

Information Systems......Panalog 605 supplies management control information. Periodically logs & continuously scans. Completely flexible. Guides management in raising plant output & profit. Request data.
290 *Panellit, Inc.

Laboratory Equipment......Company makes available a catalog describing its line of top-quality tables, cases, cabinets, fume hoods & radio chemical lab equipment. For more details, request Catalog.
BL441 *Duralab Equipment Corp.

Laboratory Glassware......Makes available a revised 139 p. catalog of custom-made Pyrex Brand laboratory glassware. New listing illustrates and describes over 6000 special glass apparatus items. Catalog No. CA-2.
465C Corning Glass Wks.

Laboratory Service......Reference describes the Rietz Laboratory Service: size reduction; continuous mixing and dissolving; heat exchange. Briefly describes product line. Request Bulletin No. 200.
465D Rietz Mfg. Co.

Research......"Rensselaer Research" reviews status of current research at the Institute & offers thumbnail sketches of the men directing some of the newer projects. Features story on "Petroleum Jellies." Vol. 1 No. 1.
465E Rensselaer Polytechnic Inst.

Research & Development......"Scientific Analysis of Flavor & Odor" tells how Evans can work for you in developing new products, in controlling the processing of existing products to assure uniformity, etc.
465F *Evans Research & Develop.

Safety Equipment......Scott Air-Paks cut repair & maintenance costs. On hazardous jobs, Air-Paks help management & labor to breathe easier. Request booklet, "Scott Air-Paks Save Money, Man hours."
336 *Scott Aviation Corp.

Surface Chemistry......New applications predicted for surfactants—describes new role of surface chemistry in modern technology in booklet, "Explore, Expand & Diversify with Surface Chemistry at Foster D. Snell."
465G Foster D. Snell, Inc.

Waste Treatment, Industrial......A technical report describes several practical systems for process and waste water treatment utilizing controlled volume pumps to meter chemicals and additives. Tech. Paper No. 64.
465H Milton Roy Co.

*From advertisement, this issue

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EQUIPMENT

IMPERVITE equipment is unaffected by the action of all corrosives except a few highly oxidizing agents. This material provides excellent thermal conductivity (5 times that of stainless) and is immune to effects of thermal shock. For new equipment or replacements, consider the following facts: Original cost of IMPERVITE equipment is surprisingly low because of a high degree of standardization. Operating efficiency is of the highest level, and impervious graphite normally will provide a longer service life than any other material of construction.

TUBE & SHELL HEAT EXCHANGERS

Standard components are carried in stock for quick delivery of most IMPERVITE Tube and Shell exchangers from 7 to 650 tubes in 9 and 12 foot lengths. All normal tube and shell design features are available as standard. Custom designs are furnished on order.

CUBICAL HEAT EXCHANGERS

... provide maximum transfer surface in minimum space ... and only Falls Industries offers a complete, standardized line of CUBICAL exchangers to meet most requirements. This design accommodates operating pressures in the 150 psi range.

CROSS-BORE* HEAT EXCHANGERS

Featuring a rugged, heavy-duty, one-piece bundle, CROSS-BORE exchangers are furnished in standard, single and multi-pass models for heat transfer areas to 187 square feet. CROSS-BORE exchangers are especially easy to clean, and withstand operating pressures in the 150-200 psi range.

CASCADE COOLERS

IMPERVITE Cascade Coolers feature low-pressure-drop ells and flush nozzles. As standard models they are furnished in 5 tube sizes, and three different models.

CENTRIFUGAL PUMPS*

Outstanding service is afforded by the Falls designed seal, which is virtually leak-proof. Standard IMPERVITE pump models are furnished up to 200 gpm, 100 ft. head, and specials are available in the range of 1000 gpm.

RUPTURE DISKS*

... a new idea in frangibles from Falls ... expendable and economical. IMPERVITE Rupture Disks are standard for 150# flanges, temperature to 300° F., 5% accuracy, diameters from 2" to 12". Specials are furnished to 30" diameter, to 250 psi burst, to 700° F. temperature.

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Index to Advertisers

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Abbe Engineering Co..... 442
Air Preheater Corp..... 80
Air Reduction Co..... 261
Airtemp Construction Corp... 34
Alco Products, Inc..... 30
Aldrich Pump Co..... 459
Alemite Div. of Stewart
Warner 239
Allegheny Ludlum Steel Corp. 296
Allen Bradley 274
Allied Chemical & Dye Corp.
Baker & Adamson Products,
General Chemical Div..... 149
Barrett Div. 277
General Chemical Div..... 109
Nitrogen Div. 121
Solvay Process Div..... 147
Semet-Solvay Div. 123
Nat. Aniline Div..... 401
Allis-Chalmers Mfg. Co.;
General Machinery Div..... 245
245A-245B, 283, 307
Allis Co., Louis..... 388
Alloy Steel Products..... 222A
Alsop Engrg. Corp..... 355
Aluminum Co. of America
Process Div. 37
Alvey Conveyor Co..... 350
Amercoat Corp. 233
American Agile Corp..... 343
American Air Filter Co..... 222
American Blower Corp..... 41
American Brass Co., The
Anaconda Div. 268
American Cyanamid Co.... 212-213
American Hard Rubber Co. 326-327
American Instrument Co..... 351
American Machine & Metals,
Inc.
DeBothezat Div. 209
Niagara Filter Div..... 422
Tolhurst Div. 423
U. S. Gauge Div..... 457
American Optical Co..... 70
American Pulverizer Co..... 359
Ampco Metals Inc..... 460
Annin Co., The..... 155
Appleton Electric Co..... 91
Armour Co. 48-49
Atlantic Metal Hose Co..... 380D
Atlas Mineral Products..... 440
Atlas Powder Co., Darco Div. 383
Autoclave Engineers 404
Automatic Switch Co..... 231

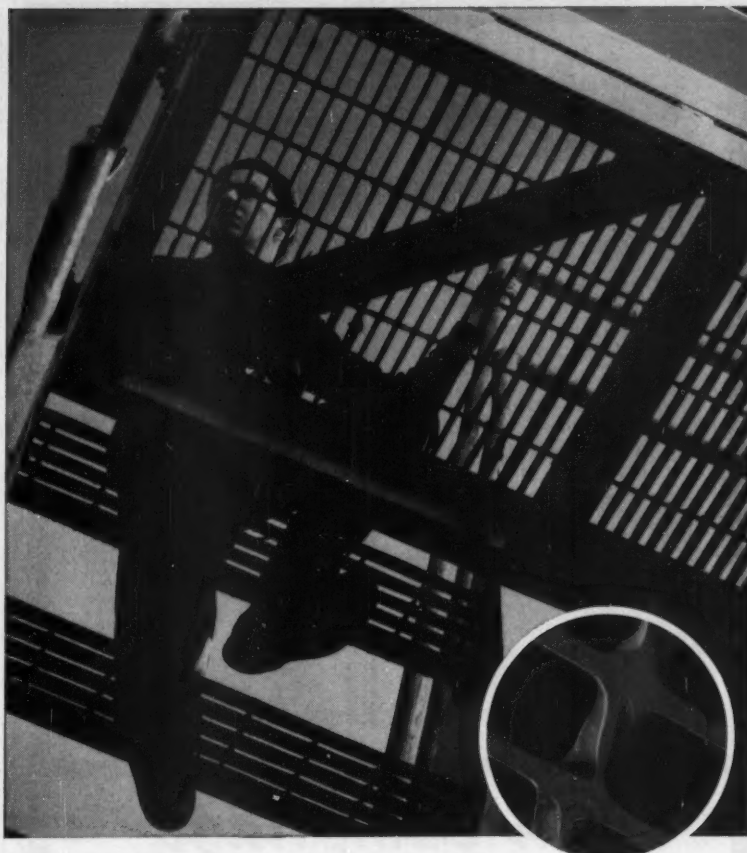
Babcock & Wilcox Co..... 395
Bailey Meter Co..... 301
Baker Co. 263
Baker-Perkins 28
Barber-Greene Co. 439
Barco Mfg. Co..... 452
Bart Mfg. 354
Bechtol Corp. 67
Bell & Gossett Co..... 157
Bendix Computer Div. Bendix
Aviation Corp. 33
Bethlehem Steel Co..... 52, 99
Bird Machine Co..... 11
Black, Sivalls & Bryson, Inc.
Safety Head Div..... 319
Blaw-Knox Co.
Bufflovak Div. 364
Equipment Div. 467
Sprinkler Div. 294
Boardman Co., The..... 437
Bridgeport Brass Co..... 368
Bristol Co. 234-235
Brookfield Engrg. Labs..... 329
Brunner Mfg Co..... 75
Buell Engineering Co..... 86
Buffalo Forge Co..... 66
Buffalo Pumps Inc..... 436
Calumet & Hecla Inc.
Wolverine Tube Div..... 447-448
Cambridge Wire Cloth Co.... 468
Carbide & Carbon Chemical Co.
Div. of Union Carbide &
Carbon Corp. 145
Carborundum Corp. 373
Carlson, Inc., G. O..... 287
Carpenter Steel Co.
Alloy Tube Div..... 380B
Catalytic Const. Co..... 267
Ceilcote Co., The..... 427
Celanese Corp. 380C
Chapman Valve Co..... 14
Chase Brass & Copper Co.... 40

Chemical Construction Corp. A
Unit of American Cynamid 391
Chemical & Power Products
Inc. 426
Chemsteel Construction Co.,
Inc. 405
Chemstrand Corp. 403, 406
Chicago Bridge & Iron Co.... 125
Chiksan Co. 399
Childers Corp. 282
Clarage Fan Co..... 61
Cleaver-Brooks Co. 39
Colton Co., Arthur..... 343
Combustion Engineering Inc.,
Raymond Pulverizer Div... 314
Commercial Solvents Corp... 333
Consolidated Electrodynamics
Corp. 367
Cooper Alloy Corp..... 293
Coppus Engineering Co..... 77
Corning Glass Works..... 389
Cowles Chemical Co..... 421
Crane Co. 313, 381-382
Crane Packing Co..... 344
Crouse Hinds Co. 251
Crucible Steel Co. of America
Stainless Steel Div..... 249
Cuno Engineering Corp.
Poro-Klean Div..... 270
Super Auto Klean Div..... 254
Darling Valve & Mfg. Co.... 338
Davenport Machine & Foundry
Co. 343
Day Co., J. H..... 339
Dean Brothers Pumps, Inc.... 461
Dean Products Inc..... 441
DeLaval Steam Turbine Co... 243
Dempster Bros. Inc..... 302-303
Dexter & Sons, C. H..... 85
Dorr-Oliver, Inc. 106-107
Dow Corning Corp..... 353
Dowell, Inc. 392
DuPont Co., E. I.
Electrochemicals 340, 341
Plastics Div. 385
Durable Co. 324
Duralab Equipment 441
Duraloy Co. 458
Durametallic Corp. 345
Duriron Co. 288-289
Dustex Corp. 355

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Eagle-Pitcher Co.	46
Eastern Industries	372
Eastman Kodak Co.	
Industrial Photographic Div.	68
Eimco Corp., The.....	57
Elliott Co.	454
Enjay Co., Inc.....	151
Eriez Mfg. Co.....	97
Evertite Coupling Co.....	332
Falls Industries Inc.....	465
Fansteel Metallurgical Corp... ..	446
Farris Engineering Co.....	26-27
Filtration Engrg.	281
Firestone Plastics Co.....	363
Fisher Governor	217
Fischer & Porter Co.....	394
Flexitallic Gasket Co.....	312
Foster Engineering Co.....	471
Foster Wheeler Corp....	137, 221
Foxboro Co.	44-45
Frick Co., Inc.....	430
Fuller Co., The.....	65
Gardner Denver Co.....	56
General Electric Co....	53, 100-101
140-141, 284, 31	
Girdler Co.	2nd Cover
Glycerine Producers Assoc....	241
Golden-Anderson Valve Spec.	
Co.	345
Goodrich Co., B. F.	
Geon Div.	12
Industrial Div.	19
Goulds Pumps Inc.....	266
Graver Tank & Mfg. Co., Inc.	366
Gray Co.	433
Grinnell Co., Inc.....	16
Gustin Bacon Mfg. Co.....	95
Hagan Corp.	38
Hardinge Co.	322
Harrisburgh Steel Corp.....	353
Harshaw Chemical Co., The..	98
Hart-Carter Co.	396
Henszey Co.	357
Hercules Powder Co.....	82
Heyl & Patterson Inc.....	451
Hilliard Corp.	346
Hills-McCanna Co.	229
Hoke, Inc.	445
Homestead Valve Mfg. Co....	156
Hooker Electrochemical Co... ..	154
Illinois Testing Labs.....	345
Independent Engineering Co..	332
Industrial Filter & Pump Mfg.	337
Ingersoll-Rand Co.	377
International Nickel Co.	306
International Salt Co.	305
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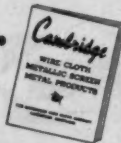
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Kirk & Blum Mfg. Co., The	449
Klinger Limited, Richard	133
Koppers Co.	
Industrial Gas Cleaning	291
Koven & Bros., Inc., L. O. . . .	153
LaBour Co., Inc., The	237
Lapp Insulator Co.	
Porcelain Process Div.	361
Lawrence Pumps, Inc.	443
Layne & Bowlar, Inc.	93
Lee Metal Products Co.	342
Leeds & Northrup Co.	96
Link Belt Co.	13, 378
Lithium Corp.	402
Littleford Bros.	453
Louisville Dreyer Div. of Gen- eral Am. Transportation Corp.	215
Lovejoy Flexible Coupling	461
Ludlow-Saylor Wire Co.	456
Lukens Steel Co., Clad Steels . .	276
Lummus Co.	117
Luria Engrg. Co.	272
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Manning, Maxwell & Moore, Inc.	94, 386
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Master Electric Co., The 3rd Cover McNally-Pittsburgh Mfg. Co. . .	356
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National Lead Co.	131
Neptune Meter Co.	450

Neville Chemical Co.....	79
Newport News Shipbuilding and Dry Dock Co.....	222B
Niagara Alkali Co.....	21
Nicholson & Co., W. H.....	349
Nordstrom Valve Corp....	347-348
Norton Co.	83
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Ohio Injector Co.....	87
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OPW Corp.	298
Oronite Chemical Co.....	135
Owens Corning Fiberglas Corp.	393
Panellit Co.	290
Pangborn Corp.	358
Patterson Foundry & Machine Co.	334, 335
Patterson Kelley Co., Inc....	105
Peerless Mfg. Co.....	325
Penberthy Injector Co.....	374
Pennsylvania Flexible Metallic Tubing Co.	50
Perkin-Elmer Corp.	112, 317
Permutit Co.	219
Pfaudler Co.....	Back Cover
Pfizer & Co., Charles.....	119
Philadelphia Gear Wks, Inc....	32
Philadelphia Pump & Mch. Co.	269
Pittsburgh Electrodryer Corp.	390
Powell Valves, Wm. Powell Co.	51
Powers Regulator Co.....	397
Pressed Steel Tank Co.....	15
Proctor & Schwartz, Inc.....	24
Quaker Oats Co.....	425
Raybestos-Manhattan, Inc. Manhattan Rubber Div.....	227
Read Standard Corp. Bakery-Chemical Div.	321
Blower-Stoker Div.	441
Reliance Electric & Engrg. Co. Reeves Div.	316
Rem-Cru Titanium Inc.....	88
Renneburg & Sons, Edw.....	441
Republic Steel Corp.....	370-371
Research Appliance Corp....	355
Revere Copper & Brass Inc....	257
Reynolds Metals	259
Richardson Scale Co.....	74
Robbins & Myers, Inc.....	47
Rockwell Mfg. Co.....	297
Rodney Hunt Mch. Co.....	387
Roots-Connersville Blower Corp.	435
Roper Corp., Geo. D.....	434
Ross Heat Exchanger Div. of American Standard	400
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Saran Lined Pipe Co.....	64
Sarco Co.	207



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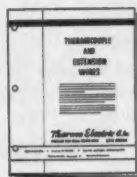


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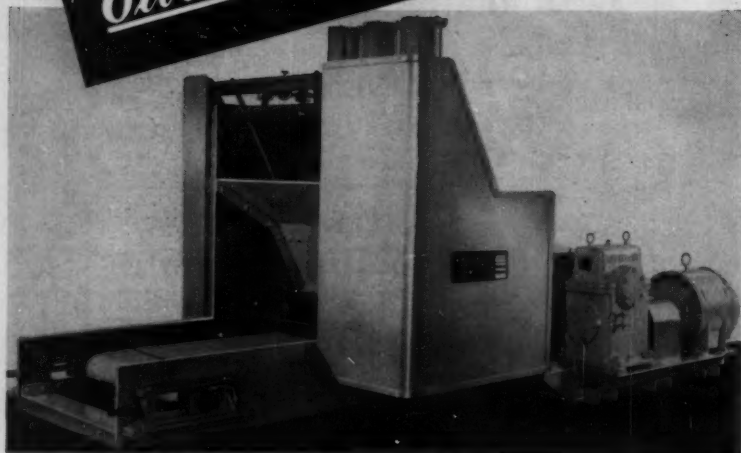


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Shell Chemical Corp.	111
Shippers Car Line Corp.	73
Shriver Co., T. S.	421
Sinclair Chemicals, Inc.	279
S. Morgan Smith Co.	463
Smith Co., A. O.	
Glascote Products Div.	211
Heat Exchangers & Pres- sure Vessels Div.	62-63
Speedline Stainless Steel Fit- tings Div. of Horace T. Potts Co.	439
Spray Engineering Co.	429
Spraying Systems	353
Sprout, Waldron & Co., Inc.	247
Standard Steel Corp.	433
Stokes Machine Co., F. J.	255
Stone & Webster Engrg. Corp.	69
Strahman Valves, Inc.	421
Struthers Wells Co.	60
Sturtevant Mill Co.	295
Superior Separator Co.	330
Surface Combustion Corp. Heat Treat Div.	463
Swenson Evaporator Div. Whiting Corp.	6-7
Taber Pump Co.	429
Taylor Instrument Co.	76, 286
Texas Gulf Sulphur Co.	398
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U. S. Rubber Co.	78
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Products Div.	90
U. S. Stoneware Co., The.	102
Vapor Heating Corp.	271
Viking Pump Co.	351
Vilter Mfg. Co.	438
Virginia Smelting Co.	42
Vogt Machine Co., Henry.	205
Wagner Electric Corp.	72
Walworth Co., The.	380A
Wedgeplug Valve Co.	89
Weinman Pump Corp.	331

Welding Fittings Corp.....	10
West End Chemical Corp.....	43
Westinghouse Electric Sturte-	
vant Div.	428
Wheelbrator Corp.	18
Wheeler Co., C. H.....	464
Whitlock Mfg. Co.....	92
Wiegand Co., Edwin L.....	71
Wilfley & Sons, A. R.....	81
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Williams Patent Crusher &	
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Porter Co.	323
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Co.	84

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 Equipment 410
 Miscellaneous 410

ADVERTISERS INDEX	
Adams, Joseph.....	416
American Air Compressor Corp.....	414
Barcan Co., Irving.....	414
Borden Co., The.....	408
Brill Equipment Co.....	411
Callery Chemical Co.....	406
Chemical & Process Machinery Corp.	416
Chemical Service Corp.....	410
Cities Service Oil Co.....	410
Columbia-Southern Chemical Corp.....	410
Cosden Petroleum Corp.....	408
Consolidated Products Co., Inc.....	412
Drake Personnel Inc.....	406
DuPont de Nemours & Co., E. I.....	407
Engineering Associates.....	416
Equipment Clearing House Inc.....	414
First Machinery Corp.....	415
Food Machinery & Chemical Corp.	408, 410
Ford Motor Co.....	416
Gelb & Sons Inc., R.....	417
Heat & Power Co., Inc.....	415
Lawler Co.....	416
Liquid Carbonic Corp.....	408
Loeb Equipment Supply Co.....	416
Loeb & Son, H.....	412
Logsdon Co.....	406
Luria Steel & Trading Corp.....	414
Machinery & Equipment Corp., The.....	414
McKee, Arthur G.....	406, 408
Meyer & Sons, Inc., Wm. M.....	414
Monarch Personnel.....	406
National Lead Co., of Ohio.....	409
Perry Equipment Corp.....	413
Procter & Gamble Co.....	409
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Rail & Industrial Equipment.....	412
Standard Oil Co., The.....	408
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Stein Equipment Co.....	416
Truand Chemical & Eng. Co.....	410
Union Standard Equipment.....	412, 414
Weinstein Co.....	410

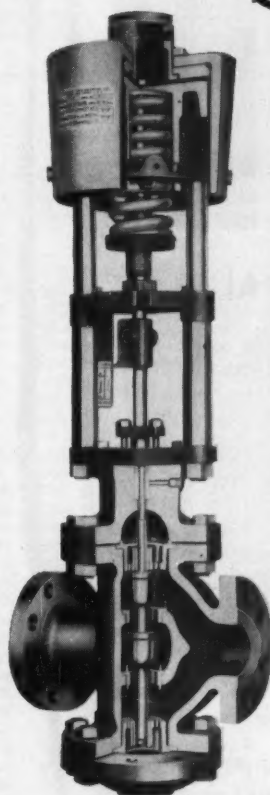
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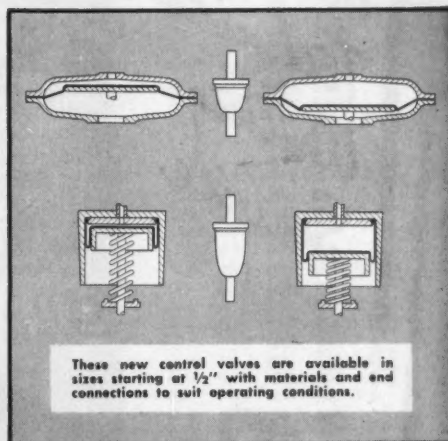
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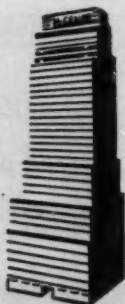
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6-7a	40	83	143	203d	240D	284	329	352b	355a	432K	437	443C	449H	R461
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8	44-5	87a	146B	203h	241	271	TR333	354	388	TL433	437E	444	453	463C
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35-6b	77	131	156	238B	252B	326-7c	350	379	432F	436D	442H	449C	459E	477
35-6c	78	133	157	239C	252C	326-7d	TL351	380	432G	436E	442I	449D	460	478a
35-6d	79	137	158	239	252D	326-7e	BL351	381-3	432H	436F	443	449E	460A	478b
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33-6b	77	131	156	238B	252B	236-7c	350	379	432F	436D	442H	486C	489E	477
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P.S. Did you miss anything in this issue?

Here's a list to help you make a quick check:

Chemotator 103

What's Happening in

New Plating Process 114
Radiant Heat 118
Tiny "Plant" 120
Furfural 126
Stress-Relieved 130
Product Mix 136

Chemical & Raw Materials

Pyridine 142

Index 144

Feature Report

Chemical Technology
of Fermentation . 159

Feature Articles

Corrosion Testing at
Elevated Temper-
atures 175

**Design Heat Ex-
changers More
Exactly** 181

**Estimating Costs for
Radiochemical
Plants** 185

**New Look at Batch
Extraction** 188

**Save Money on Bub-
ble-Cap Columns** . 193

CE Refresher

Reactor Design for
Catalytic Reac-
tions 197

Plant Notebook

Pressurized Acid
Tank Solves Two
Problems 204

Shortcut Chart for
Standard Devia-
tions 206

Installing a Propane
Dryness Indicator 208

Estimating Steam
Film Coefficients 208

Graph Solves Three-
Component Mix-
tures 210

You & Your Job

Here's How You
Could Be Treated
Better 214

Corrosion Forum

Best Designs for Lead
Installations 224

Process Equipment News

Spiral Sizer 236
Index 238
New Motor 244

Chemical Economics

'55 Profits 256
Metal Makers 260
Consumption Index. 262

Pictured Flowsheet

New Chemical Proc-
ess Wins Chro-
mium From Ore.. 308

Other Departments

Advertisers 466
Book Reviews 332
Convention Calendar 116
Firms in the News.. 341
Man of the Month.. 315
Names in the News. 316
New Technical Liter-
ature 432
Pro & Con Letters.. 326
Recent Pamphlets.. 337

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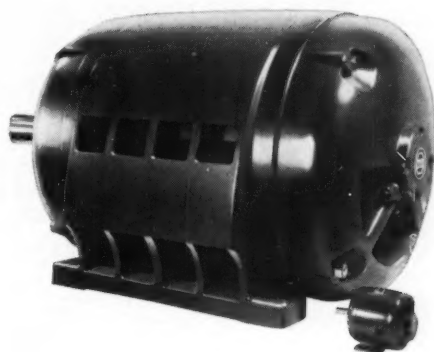
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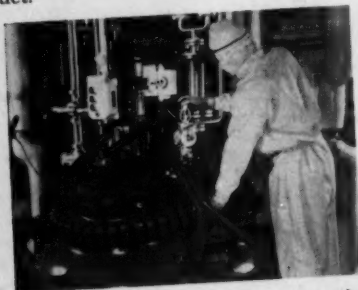
Quick facts about the services and equipment Pfaudler offers to help you reduce corrosion and processing cost.



How to protect color and purity of plasticizers during polymerization

Color and purity are the *primas* of the polymerization process.

Contamination can spoil both. To avoid it, you need equipment that is easy to clean between each run, that resists the corrosive action of the chemicals involved, and that does not put metal in contact with your product.



This glassed steel polymerizer, used in the manufacture of polyester resin, helps protect product from contamination.

That's why Pfaudler glassed steel reactors have found universal application as polymerization vessels.

Practically nothing sticks to their glassed interior. They wash clean quickly and easily between runs, avoiding contamination of succeeding batches.

Resisting all acids (except hydrofluoric) and alkaline solutions up to pH 12 and 212° F., Pfaudler acid-alkali-resisting glassed steel protects your product from contamination and protects your equipment investment from excessive replacement needs.

Full year's guarantee against corrosion

In fact—the corrosion resistance of Pfaudler glassed steel is so well documented that we offer a full year's guarantee against corrosion destruction, under the conditions for which the vessel is sold. 12 months of 100% freedom from corrosion, even if you process 24 hours a day!

Nonmetallic

Contamination by metals—particularly iron—can cause discoloration of your product. You get the tremendous strength of steel, but not the ferric contamination, when you use glassed steel. The glass is permanently bonded. It doesn't peel or flake off. Write or call for additional details.

Hundreds of stainless steel dimples cut kettle costs as much as 20%

If you need a jacketed stainless steel reaction kettle—for nonpressure use, or for high pressures—you can cut up to 20% off its initial cost with the Pfaudler dimpled jacket design.

This exclusive design permits the use of a lighter gauge metal in the jacket, yet strengthens the metal to the point where it is as strong as, or even stronger than a nondimpled, heavier jacket would be.

The dimples are hundreds of indentations with reinforced welds, and they are obtainable in low-cost standard reactors from 750 to 2000 gallons.



Specially built dimpled jacketed reactors, like this one, have been fabricated as large as 7,000 gallons.

Jackets may be either carbon or stainless steel.

You get greatest savings on reactors requiring a jacket pressure of 150 psi, but even when you only plan to use 50 psi, the Pfaudler dimpled jacket uses less material and costs less than conventional jacketing.

Besides the standard designs up to 2,000 gallons, you can also enjoy the benefits of this dimpled construction in special custom reactors built to meet your special needs.

The National Board of Boiler and Pressure Vessel Inspectors have approved this construction for 150 psi jacket pressure, and we can supply vessels bearing the code stamp.

Heating and cooling is as fast as with conventional jackets, and in many cases has proven faster.

If heat treating is desired, Pfaudler has complete facilities to heat treat stainless steel jackets of this dimpled type, giving you exceptionally long-lasting equipment.

Low-priced heat exchanger has 8 valuable virtues



An electronically controlled roller expander locks the tubes in position in the tube sheet during careful fabrication at Pfaudler.

Pfaudler fixed tube sheet heat exchanger is simple in design, has 8 advantages:

1. **Versatility**—Most widely used type of heat exchanger in the chemical industry. Used as a heater, cooler or condenser.
2. **Easy cleaning**—Tubes are straight and you clean them easily by simply removing the heads. Shell side may be flushed with chemical solutions.
3. **Low cost**—Because of large quantity production, standardized design, and use

of full tube bundles, prices of fixed tube type heat exchangers are the lowest per square foot of any heat exchanger.

4. **Fast delivery**—A large number of Pfaudler fixed tube sheet stainless heat exchangers are maintained in stock, and you can often get delivery within one week when required.

5. **Replacement of parts**—Pfaudler carries a complete line of standard heat exchanger parts in stock and shipment may be made on short notice.

6. **No intermix**—The tube sheets are welded to the shell. Therefore, there is no possibility of tube side fluid mixing with shell side fluid since there are no internal gaskets.

7. **Expansion diaphragm**—When necessary, an expansion diaphragm may be installed to take care of differential expansion between the shell and tube side.

8. **No leakage**—By means of an electronically controlled torque tube expander, leakproof joints are obtained between tubes and tube sheets.

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